

Heathkit™
HW-101 HF-Transceiver

Audio Amplifier V14 with 14GW8/PCL86

to avoid excessive cost of 6GW8/ECL86

Comparative Tables and Solution



Preface: The Small Print

When using the information on these pages for your work please note the following terms and conditions. By using any of the information presented you accept these terms. Thank you!

Restoration Projects Philosophy

The purpose of many restoration projects described here is to bring the antique equipment back into working condition close to original specifications while generally preserving their historic electronic and mechanical design. This means that often new components (e.g. capacitors) need to be used - in many cases NOS will not do - which sometimes require small mechanical modifications to the set.

This treatment does not conform to "museum" standards that require everything to be left or restored to original. This is an entirely different approach. It is up to you to decide what you want to do.

Modifications and Homebrew Projects

The projects shown are for information only with the main goal to motivate fellow amateurs and hobbyists to start on similar projects. Comments for improvements are always welcome. They are always "prototypes" and not a kit. You'll have to find your own parts. No warranty is given nor implied that they actually work in your situation.

And please note that a modified piece of equipment loses its collector value - but brings joy to its successful operator!

Copyright

Some of the circuit diagrams, manual pages or software used and edited are covered by copyrights of their original publishers and intended here for personal use only. No complete manuals can be found, there are already many sources on the web for this purpose.

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Regulations

Many of the described obsolete radios (or computers) no longer fulfill today's requirements for e.g. electrical safety, EMC, used bandwidth, levels of harmonics or spurs or intermodulation. While at times suitable corrective action is included in my descriptions, many times it is not. It is your responsibility to make sure your equipment conforms to the requirements in your own country.

Safety while Working on the Projects

It is your own responsibility and all-important to always observe proper safety procedures in your work. Some of these projects - certainly almost all vacuum-tube circuits - involve high voltages, some lethal indeed. Make sure you understand what you are doing or else get some qualified help here.

Always "Switch to Safety" when you work on your equipment! Please pay attention to proper grounding of all metal chassis and enclosures and consider the use of GFCI breakers to your shack/workbench.

This information and much more can be found on my website hb9aik.ch

1. Project Idea

For quite some time, prices for **6GW8/ECL86** tubes have gone up, reaching a rather prohibitive level today. Looking at e.g. a large supplier of NOS tubes (vacuumtubes.net), one finds the price to be quoted at USD **50.00!**

This price has to be set into relation to the value of the radio and also to a viable alternative: the **14GW8/PCL86**, which differs in the heater rating but is otherwise identical. It costs only USD **4.00** from the same source!

The idea then is to find a new configuration for the series-parallel heater arrangement in the HW-101 that can be implemented with minimal changes and use a 14GW8/PCL86.

2. Analysis

The HW-101 uses a partial series-parallel arrangement for the heater circuits to be able to use 6.3V tubes with a 12.6V power supply, reducing the required current but also convenient with the HP-13 DC/DC converter in a car.

The original design as listed in **Table 1** has some peculiarities: V17, V19 are connected directly across the 12.6V and the center of the combinations V2+V16 and V3+V4 is not connected to what I called the «6.3V rail». To calculate the total current that flows through the node «6.3V rail», these need not to be taken into account. The 6GW8 is part of the 6.3V to GND (right) group.

Replacing the 6GW8 with a 14GW8/PCL86 requires the heater of this new tube to be connected directly across 12.6V, thus unbalancing the heater circuit. A compensation has to be found to rebalance the voltage divider. As shown in **Table 2**, the solution lies in rearranging the two dial lamps DL from the left to the right group. It was only after drawing up the two tables that this extremely simple solution was obvious!

Notes:

- *nominal heater voltage of the 14GW8/PCL86 is 13.3V, i.e. 12.6V is only 95%. This is however fully acceptable here as the tube is run at a lower plate current.*
- *the values for the heater currents used in the tables are nominal values and a tolerance applies. That might be the reason why Heath engineers used the two 6146 as base load on this voltage divider to take up some of the differences in the small tubes.*

3. Implementation

Refer to Pictorial 8-4, page 61 and X-ray view on page 189 of the manual. On printed circuit board 85-130 (audio circuit board) disconnect the two brown wires («6.3V rail») to pin 4 of V14 (17). Twist and solder the ends of the two brown wires, insulate ends and bend back to the cableform.

Connect a white wire from V14 pin 4 (17) to V15 pin 5 (12), where two white/brown wires (12.6V) are already connected (S-3). You may want to put a short piece of shrink tubing over the ends of the white/brown wires to prevent the insulation be damaged while soldering. Beware of shorting to pin 4 (13).

The heater to V14 is now connected between 12.6V and GND.

On the front panel refer to Pictorial 8-14 and page 87 of the manual to disconnect (cut) one white wire from hole 21 of the IF circuit board to the dial lamp holder DH. Install a new lock washer under the screw holding the lamp holder at DH and connect the white wire to it (S-1). Check that both dial lamps are indeed #47.

The dial lamps are now connected between «6.3V rail» and GND.

Remove V14 6GW8 and replace by a 14GW8/PCL86. Install a warning label on side panel indicating the change!

When back in operation you may check the voltage on the 6.3V rail, it should be $\frac{1}{2}$ of the heater voltage supplied. Due to the tolerances in heater currents a small deviation is ok.

This completes the modification. Good luck!

Table 1

| Heathkit HW-101 Heater Circuits, original | | | | | | | | | |
|---|----------|-----|-------|-----------|---|-----|-------|------|---|
| p/c # | 12.6V IN | | | 6.3V rail | | | GND | | |
| 85-127 | • | V2 | 6AU6 | 0.30 | ↔ | V16 | 12AU7 | 0.30 | • |
| | | | | | • | V1 | 6EA8 | 0.45 | • |
| 85-128 | | | | | • | V13 | 6BN8 | 0.60 | • |
| | • | V3 | 6AU6 | 0.30 | ↔ | V4 | 6AU6 | 0.30 | • |
| 85-129 | • | V12 | 6EA8 | 0.45 | • | | | | |
| | • | V5 | 6EA8 | 0.45 | • | | | | |
| | • | V17 | 12AT7 | 0.15 | | | | ↔ | • |
| | • | V19 | 12AT7 | 0.15 | | | | ↔ | • |
| 85-130 | • | V15 | 6EA8 | 0.45 | • | V14 | 6GW8 | 0.70 | • |
| 85-131 | | V7 | 6CL6 | 0.65 | • | V11 | 6HS6 | 0.45 | |
| | | | 6HS6 | 0.45 | • | V6 | 6CB6 | 0.30 | • |
| chassis | • | V8 | 6146 | 1.25 | • | V9 | 6146 | 1.25 | • |
| | • | DL | #47 | 0.15 | • | | | | |
| | • | DL | #47 | 0.15 | • | | | | |
| | | | | | • | V20 | 6AU6 | 0.30 | • |
| Subsum (relevant for 6.3V rail) | | | | 4.00 | A | | | 4.05 | A |
| Δ | 1.3% | | | -0.05 | A | | | 0.05 | A |

direct, not relevant for balance
 Notes: - p.m. V18 is 0A2, no heater
- both 6HS6 changed to 6AU6: no difference

Table 2

| Heathkit HW-101 Heater Circuits, new: PCL86/14GW8 instead of 6GW8/ECL86 | | | | | | | | | |
|--|----------|-----|-------|-----------|---|-----|-------|-------|---|
| p/c # | 12.6V IN | | | 6.3V rail | | | GND | | |
| 85-127 | • | V2 | 6AU6 | 0.30 | ↔ | V16 | 12AU7 | 0.30 | • |
| | | | | | • | V1 | 6EA8 | 0.45 | • |
| 85-128 | | | | | • | V13 | 6BN8 | 0.60 | • |
| | • | V3 | 6AU6 | 0.30 | ↔ | V4 | 6AU6 | 0.30 | • |
| 85-129 | • | V12 | 6EA8 | 0.45 | • | | | | |
| | • | V5 | 6EA8 | 0.45 | • | | | | |
| | • | V17 | 12AT7 | 0.15 | | | | ↔ | • |
| | • | V19 | 12AT7 | 0.15 | | | | ↔ | • |
| 85-130 <i>changed</i> | • | V15 | 6EA8 | 0.45 | • | | | | |
| | ■ | V14 | 14GW8 | 0.30 | ↔ | | | | • |
| 85-131 | | V7 | 6CL6 | 0.65 | • | V11 | 6HS6 | 0.45 | |
| | | V10 | 6HS6 | 0.45 | • | V6 | 6CB6 | 0.30 | • |
| chassis | • | V8 | 6146 | 1.25 | • | V9 | 6146 | 1.25 | • |
| | | | | | • | DL | #47 | 0.15 | ■ |
| | | | | | • | DL | #47 | 0.15 | ■ |
| | | | | | • | V20 | 6AU6 | 0.30 | • |
| Subsum (relevant for 6.3V rail) | | | | 3.70 | A | | | 3.65 | A |
| Δ | 1.4% | | | 0.05 | A | | | -0.05 | A |

new connections
 Notes: - p.m. V18 is 0A2, no heater
- both 6HS6 changed to 6AU6: no difference
- ■ new connection