

Heathkit of the Month #27:
by Bob Eckweiler, AF6C



**Heathkit MP-10
 AC Power Inverter.**

Introduction:

In the 1960's AC inverters that convert 6 or 12 volt battery power to 117 VAC 60 Hz power were not nearly as readily available as they are today. Heathkit filled this need with the MP-10. Originally one of the Heathkit marine products to allow boat owners to use TVs and small appliances while away from shore power, the MP-10 quickly found numerous other uses. Radio hams, campers, car enthusiasts and emergency preparedness groups found the device versatile for their needs.

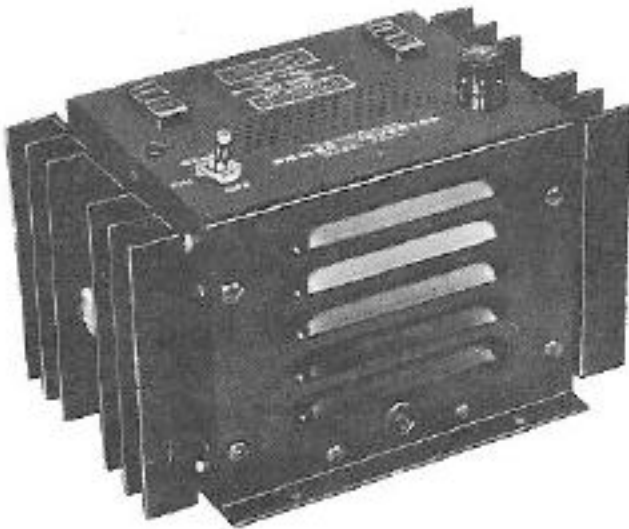


Figure 1: Heathkit MP-10 AC Power Inverter

The MP-10 experienced one of the longest Heathkit production runs. It was manufactured for twenty-two years without any upgrade or model change. The MP-10 was introduced in 1960 and remained in production until at least mid 1982. The MP-10 sold for \$29.95 in the March 1965 catalog, \$34.95 in the Christmas 1973 catalog, and \$49.95. In the summer 1982 catalog. Retail Heathkit stores usually sold the kit at an additional \$5.

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The MP-10 Power Inverter:

The Heathkit MP-10 (Figure 1) requires either 6 VDC or 12 VDC power and converts it to 117 VAC power. The output is a square wave, not the sinusoidal power normally available from the AC mains (See the Sidebar). The MP-10 is rated at 120 watts output when running off 6 VDC, and 175 watts when running off 12 VDC. On 12 volts it can supply up to 240 watts intermittently. The efficiency of the inverter varies with power delivered. From about 80 watts to 200 watts (120 watts when using a 6V source) the efficiency is around 80%. At the full 240 watts it drops to about 70%. Low power output (around 20 watts) results in an efficiency around 50%. With no load the inverter draws about 18 watts. The MP-10 draws 25 amps under maximum rated load for the given input voltage.

The unit itself measures 7-3/8" L x 5-1/8" W x 4-3/4" H. A heavy heat sink adorns both ends, and mounted to each heat sink is a power transistor. The heat sinks may be mounted in two different orientations so, depending on whether the unit is mounted on a horizontal or vertical surface, the heat sink fins may be oriented vertically for best cooling. The front and rear of the unit have louvered ventilation slots and the top contains the power **OFF - ON - START** switch, a 3AG fuse holder for a 25 amp fuse, and two two-prong AC power outlets. The power switch **START** position is a momentary position and is used for starting when using a six-volt power source. Underneath the unit are two terminal strips for selecting either 6 or 12 VDC operation by jumper wires, and two #10-24 studs with wing nuts for connecting the input power. Heath recommends using heavy #10 wire with a short 10 foot maximum run to the battery to reduce external losses.

While the #10 wire is not included in the kit, the kit does include a #28 drill and two special studs. Instructions are given for drilling holes in the center of the battery terminals so the studs may be pressed in. The wire leads can

then be attached easily to the battery using a supplied thumbnut that screws onto the stud. If you need to turn the inverter on remotely, the manual suggest placing the MP-10 near the battery and using an automotive relay to turn the unit on and off.



Figure 2: Heath MP-10 Manual

The Circuit:

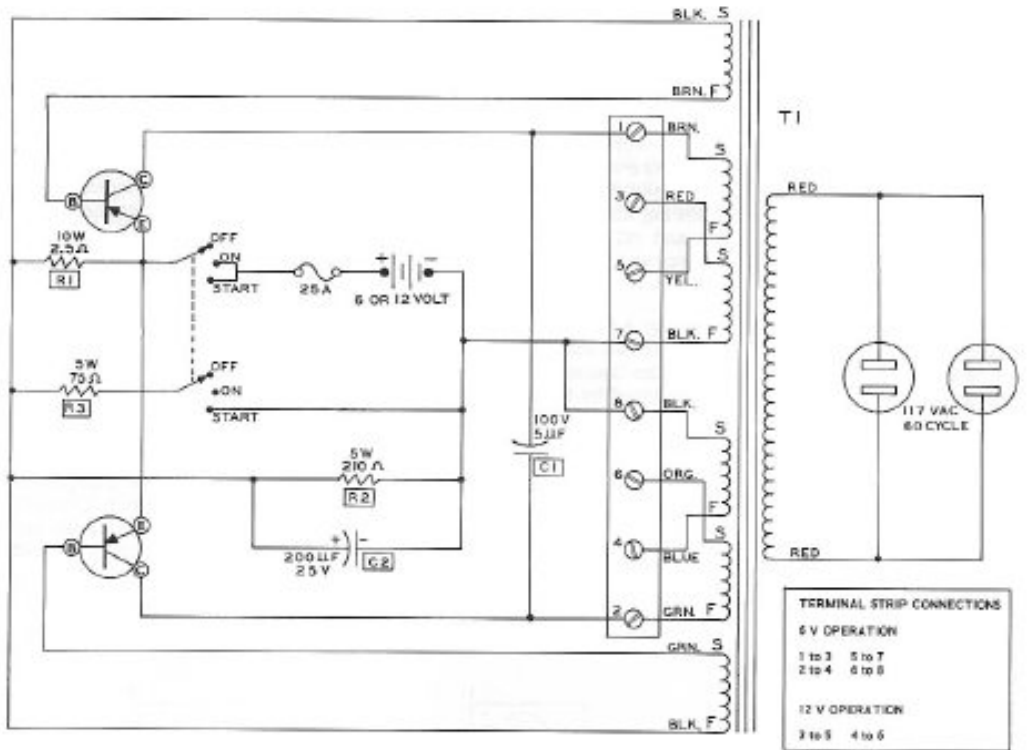
The circuit is shown in figure 3. The heart of the circuit is T1, a specially wound transformer. When power is applied any small differences in the transistors or transformer feedback windings will cause one of the transistors to turn on. The windings on the transformer are arranged so that as the transistor turns on more current is supplied to the base of that transistor turning it on fully; meanwhile the other transistor is driven deeply into cutoff, preventing it from conducting. The transformer core characteristics are such that, after a time, the core goes into saturation and the transistor that was on turns off, and the other transistor turns on. The strong positive feedback to the base of the transistors cause them to switch quickly from off to full on. Since no power is dissipated when the

transistor is off and only a little is dissipated when the transistor is fully on, most of the heat is generated by the transistor while in the process of switching. The faster the switching occurs the better the efficiency and the less heat is generated. R2 provides the starting current. R3, switched in when the Power Switch is in the **START** position, provides additional starting current to assist when using low input voltage, and may be required to start oscillations under certain loads. The capacitors prevent transient spikes from damaging the transistors.

The two switching transistors used carry the Heathkit Part # 417-60 and are described in the manual as having commercial part # of SP-838 or CRT-3602A. I could not find a data sheet or source for these transistors on the web. As would be expected, high power (100W) high current (25A) germanium PNP transistors are no longer in heavy demand. Looking at a kit, I saw the transistors were made by Lansdale Semiconductor and carried a date code of 1982. Lansdale is a house that will do production runs of outdated semiconductors, so even Heathkit had to find a new source near the end of their production run. Numerous web pages do suggest alternatives, some costing more than the whole kit for one transistor.

My first encounter with the MP-10 occurred when I was in high school. One of my older ham friends was leaving for college and passed along his MP-10 to me. Not owning a boat, I first used it to power a borrowed Clegg VHF radio and ran my first portable station. Of course the owner of the Clegg came along and we made a few two-meter AM contacts. There aren't many tall hills on Long Island! On numerous other occasions it was put to good use including a trip to Gilgo Beach (east of the famous Jones Beach) to run a record player at our senior beach party. Yes we got a couple of jocks to lug two car batteries from the parking lot out into the sand. The 60 Hz frequency of the MP-10 varies with load so it took some adjusting to get the frequency close enough so Elvis sounded like Elvis and not "The Chipmunks"!

I don't recall what I did with that MP-10 from the early sixties? Perhaps it is back in the hands of the person who gave it to me. In 1965 I was moving to California and gave away a lot of goodies from that era. Today I have a different MP-10 Power Inverter, unbuilt and still in the box - part of my small collection of unbuilt Heathkits. Maybe someday I'll make a YouTube video of it being assembled.



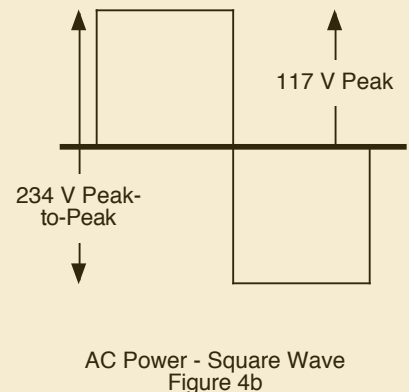
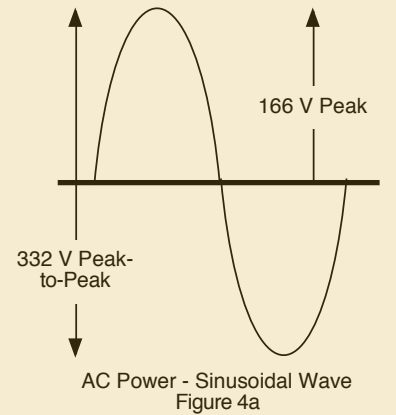
UH OH, next month is April. I'll have to come up with a special Heathkit for the occasion!

73, from AF6C



Sine vs. Square waves:

The 117 VAC power that is delivered to homes in the US is sinusoidal in shape, reaching peaks of 166 volts positive and negative alternately as shown in figure 4a. The MP-10 and most modern AC inverters output a square wave, where the voltage jumps rapidly between positive 117 volts and negative 117 volts as shown in figure 4b. If you were to mathematically examine the area under the two curves you would find that they are equal and the power delivered is the same. However, square wave power has some drawbacks. It is made up of numerous odd harmonics of the fundamental frequency, and can produce radio noise; it doesn't work well with some loads and some newer cheap power supplies that rely on the impedance of a capacitor to drop voltage. On tube equipment, many of the power supplies are capacitor input and rely on the peak voltage to create the nominal supply voltage. A square wave will produce a lower voltage from these power supplies, but in most cases the device should work adequately.



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 March 2011 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.