Re: Heathkit clock speaker?

Source: http://sci.tech−archive.net/Archive/sci.electronics.repair/2008−09/msg00610.html

- *From*: "ian field" <gangprobing.alien@xxxxxxxxxxxx>
- *Date*: Sun, 21 Sep 2008 15:54:26 +0100

"Franc Zabkar" <fzabkar@xxxxxxxxxxxxxxxxx> wrote in message news:p0a8d4pi7n71559o3s5kf0b96544e07n13@xxxxxxxxxx

> On Fri, 19 Sep 2008 09:41:51 −0700, Jeff Liebermann <jeffl@xxxxxxxxxx>
> put finger to keyboard and composed:
>
> > On Fri, 19 Sep 2008 17:34:40 +1000, Franc Zabkar
> > <fzabkar@xxxxxxxxxxxxxxxxx> wrote:
> >
> > > On Thu, 18 Sep 2008 13:59:55 −0700, Jeff Liebermann
> > > <jeffl@xxxxxxxxxx>
> > > put finger to keyboard and composed:
> > >
> > > > On Thu, 18 Sep 2008 22:15:27 +0300, "Joe"
> > > > <natkroPOISTA@xxxxxxxxxxxxxxx>
> > > > wrote:
> > > >
> > > > > To clarify the circuit, the
> > > > > postive side of the speaker
> > > > > receives 17
> > > > > volts
> > > > > thru one diode and a resistor
> > > > > and the negative side is
> > > > > connected via
> > > > > transistor to ground and the
> > > > > transistor is driven by 4001
> > > > > IC.
> > > >
> > > > What value resitor?
> > > > What's the part number on the speaker?
> > > >
> > > > I just happen to have the manual for a
> > > > similar Heathkit GC−1005

"Electronic Clock" handy. No specs on the speaker (401−163). The
circuit is similar in that the speaker has one lead going to the
collector of an MPS−A20 and the other to 18.5VAC (not DC) through a
diode and 1200 uf to ground for a DC voltage of 25.7VDC. No resistor
in series.

So, let's do the math. My guess(tm) is that 1 watt will be
sufficiently loud to wake the dead. Yours has about a 15VDC swing.
Assuming a 50% duty cycle and a pure sine wave (yeah sure):
Power = E^2 / R
1 watt = 15^2 / R
R = 225 ohms.
So, it's probably a high impedance speaker of some sorts. I have the
digital clock and an LRC meter and could probably measure the
impedance. If you can't get the info any other way, bug me and I'll
rip it apart.

The GC−1107 supplies the speaker via a rectified 13VAC source and 150
ohm 1/2W resistor. That's a DC supply of 18V.

I believe maximum power will be transferred to the speaker if it has a
resistance equivalent to that of the series resistor, ie 150 ohm. In
this case, when the transistor is turned on, the current will be
18/300 = 60mA. Assuming a square wave signal with a duty cycle of 50%,
the power dissipated in the speaker will then be 9V x 60mA x 0.5 =
270mW.

Therefore I'm guessing that the speaker has an impedance/resistance of
at least 150 ohms and a power rating of at least 0.5W. If the speaker's impedance were any less, then the dissipation in the resistor would increase.

If we accept that the speaker should dissipate less than

> 270mW in both
> clock circuits, then in in the GC−1005 case we have ...
>
> Power(max) = 0.27 = 25 x 25 x 0.5 / R(min)
>
> So R(min) = 1157 ohms
>
> − Franc Zabkar

> I like your calcs better than mine. That suggests that Heathkit would have used something like a high impedance earphone "speaker" in the design. That's possible and probably would work quite well.
>
> However, I tore apart a similar Heathkit clock, with the identical p/n speaker, and measured 41.5 ohms DC resistance. Adding the inductance, that I didn't bother measuring, will produce about 50 to 60 ohms impedance. Obviously, this is not the optimum power transfer design, but that's what Heathkit apparently used. The important thing is that a common 4, 8, or 16 ohm speaker will NOT work.

Neither of the clock circuits makes any sense to me.

Your clock has a 25VDC supply which, at a 50% duty cycle, would cause a 41.5 ohm speaker to dissipate 7.5W.

In the OP's clock circuit, a 41.5 ohm speaker would cause the 150 ohm 1/2W resistor to dissipate ...

(18/191.5 x 0.5) x (18 x 150/191.5) = 0.66W

I can only assume that the speaker's impedance at the operating frequency of the alarm is *much* higher than one would expect. For example, at 1kHz an impedance of 100 ohms would require an inductance of 16mH. I measured the inductance of an 8 ohm 1W 3" speaker on my DMM's 2mH scale as 0.08mH and about 0.5mH on the 2mH and 20mH scales. I could hear a high pitched tone on the 2mH range (1kHz ?) and a low pitch on the 20mH range (100Hz ?).

This site appears to be dedicated to saving and restoring old Heathkit clocks:
http://www.decodesystems.com/heathkit−clocks.html

Here is some info on the MK5017 clock chip that was used in the GC−1005:
http://www.decodesystems.com/mk5017.html

The MK5017's Tone output is shown driving a 2N3904 transistor connected to a 17VDC supply through a transformer−coupled 8 ohm speaker:

> http://www.decodesystems.com/mk5017−2.gif
>
> The transformer is spec'ed as "2K/8R".
>
> I'm really clutching at straws now, but is it possible that the Heathkit speaker has a built−in 2K/8R transformer ??? Does it have the usual permanent magnet? Would it make sense to have a stationery 2K winding and an 8R moving coil on a soft iron former ???

Finding a way to reduce the duty cycle might be a means to get away with a more commonly available lower impedance speaker.

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