Heathkit of the Month #128:
by Bob Eckweiler, AF6C

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AUTOMOTIVE (Ham Related)

Heathkit GD-18 (And GDA-18-1, GDA-18-2) Electronic Siren and PA.

Introduction:

Recently I was given a batch of old Heathkit specification sheets. Heath distributed these sheets for advertising, and they offered a good overview of the product covered, often including a useable (though sometimes preliminary) schematic. While looking these over I came across two for the GD-18 Electronic Siren and PA (Public Address system). This unit, mounted under or atop the dash in a vehicle and, in conjunction with one of two types of speakers, has three functions: One: A dual-mode vehicle siren (wail and yelp) like police cars and emergency vehicles use; Two: A PA system where the driver could make announcements to people and vehicles nearby; and Three: The ability to connect the vehicle radio to the PA system and monitor radio traffic while outside the vehicle (Something that might be useful for hams).

The Heathkit GD-18:

I had trouble grasping what would be the market for the GD-18[1]? Yet, Heath saw a market, and it must have been a profitable one. The GD-18 sold from 1970 until the fall of 1983. It was then replaced by an updated GD-1810. The GD-1810 continued in production into 1988,

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

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

1. Notes begin on page 10

Figure 1: The gimbal bracket mounted Heathkit GD-18 Electronic Siren can mount under or above the dashboard. It is used in conjunction with one of two available speakers.

over a year after Heath dropped all its automotive line, except for the GD-1810 and CI-1080 Exhaust Gas Analyzer [2]. The specifications for the GD-18 are given in **Table I.**

The GD-18 was announced in the spring 1970 catalog (800-02) with a full page ad and the "New through Heath Research" emblem. It initially sold for $54.95. Two speakers were available for it; the GDA-18-1, an assembled exterior horn speaker that could be mounted on the top of the vehicle; or the GDA-18-2, a concealed speaker kit that could be mounted behind the grille of the vehicle. Each speaker initially cost $49.95. However, Heath offered package deals: The GD-18A was the GD-18 with the GDA-18-1 external horn speaker included, and the GD-18B was the GD-18 with the GDA-18-2 concealed speaker included. Either package cost $99.95.

Starting in the 1974 Christmas catalog, both the GD-18 and GD-18-2 were also available in a factory assembled version, designated the WD-5130 and WDA-5130-2 respectively. Since the GDA-18-1 sold only fully assembled, it wasn't given a new designation. The WDA-5130-2 speak-

er was discontinued in 1981 and the WDA-5130 was discontinued in early 1983.

Table II shows the prices for the GD-18 family from it's introduction until it was discontinued near the end of Heath's kit business. Since not all catalogs are available to the author, some items might have changed price or been introduced in a prior missing catalog.

The GD-18 Controls & Connections:
There are four controls on the front of the GD-18, plus the PTT switch on the microphone. Two (set-and-forget) screwdriver-adjustable controls are accessible through holes in the bottom of the cabinet.

The front panel (**Figure 2**) is edge lit plastic for easy day or night visibility of the control functions. From left-to-right are the PA/Radio **GAIN** control and integrated **OFF**-on switch (OFF is full-ccw); a **MANUAL** pushbutton switch that activates the siren when in PA mode; and a four position **FUNCTION** switch - (in cw order from the 7:30 position) **RADIO**, **PA**, **WAIL** and **YELP**. Settings involving the siren are all marked in red, while PA and radio functions are in white.

The two adjustments can be accessed by holes in the bottom of the unit using a ⅛-inch blade screwdriver. Be careful as these are rather delicate PC board 90°-mounted controls. Below the GAIN control is the **RADIO LEVEL INPUT ADJUST**, and below the FUNCTION control is the **SIREN PITCH ADJUST** control.

The rear panel layout, shown in **Figure 3**, holds from left to right, a fuse holder, a two prong power connector, and the two output transistors Q12 and Q13. Below the transistors is a six-screw terminal strip.

The fuse holder takes a 7-ampere slow-blow fuse [3]. The power connector

GD-18 Siren SPECIFICATIONS

Output Power	
Siren:	55 watts, normal intermittent duty.
PA / Radio:	20 watts continuous.
Siren Wail	
Frequency Range:	~ 550 Hz to 1300 Hz (Pitch control at center).
Sweep Rate:	~ Six seconds per cycle.
Siren Yelp	
Sweep Rate:	~ ⅓ second per cycle.
Radio Input	
Sensitivity:	0.3 V rms min. for rated output.
Speaker Req'm't	16 Ω, 75 watt (nominal), weather-proof, horn loaded driver, (Heath GDA-18-1 or GDA-18-2).
Power Req'm't	
Voltage:	12 to 15 VDC, pos. or neg. ground.
Current:	5.5 amp. max, > 1.25 amp idle.
GD-18 Measurements	
Dimensions:	7⅝" deep x 8⅜" wide x 2⅞" high, (less gimbal bracket).
Net Weight:	4 ¾ lbs. GD-18 only.
Finish:	Gunmetal Gray, wrinkle finish.

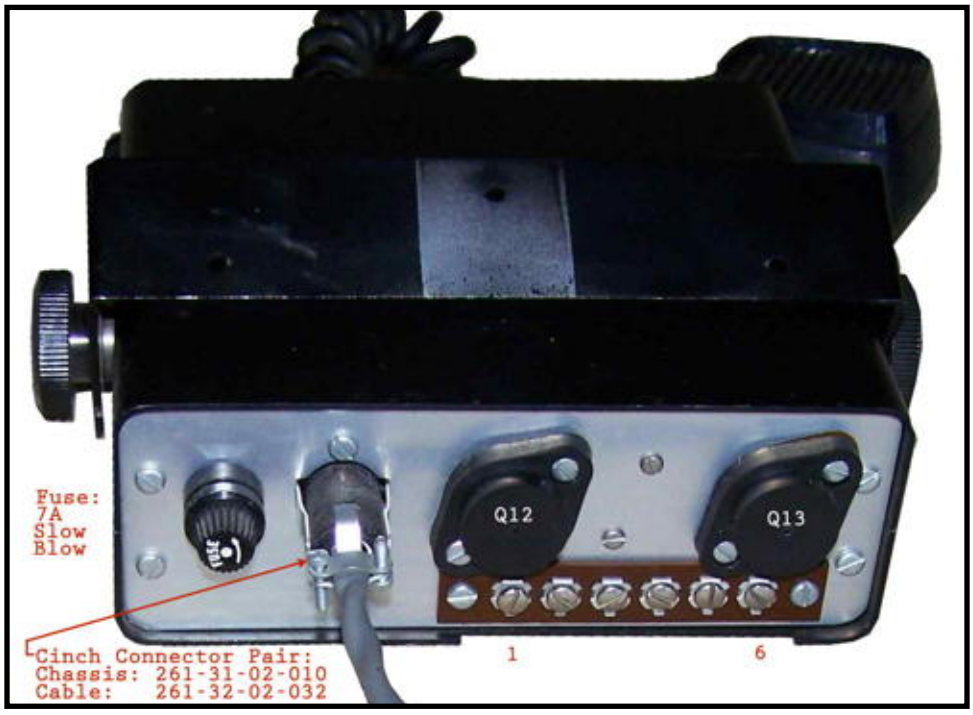
TABLE I

FIGURE 2

	Heathkit GD-18 / GD-1810 and Accessories Prices									
Year	Cat.	Pg	GD-18	WD-5130	GDA-18-1	GDA-18-2	WDA-5130-2	GD-18A	GD-18B	GD-1810
1970	800/3	30	$54.95	n/a	$49.95	$49.95	n/a	$99.95	$99.95	n/a
1973	810/72	15	$59.95	n/a	$49.95	$49.95	n/a	$104.95	$104.95	n/a
1975	806	14	$64.95	$89.95	$62.95	$62.95	$74.95	$119.95	$119.95	n/a
1976	813	18	$64.95	$89.95	$64.95	$64.95	$79.95	$121.95	$121.95	n/a
1977	818	85	$64.95	$99.95	$64.95	$64.95	$84.97	$121.95	$121.95	n/a
1978	842	79	$64.95	$99.95	$67.95	$67.95	$84.97	$121.95	$121.95	n/a
1979	847	17	$69.95	$129.95	$79.95	$79.95	$99.95	$129.95	$129.95	n/a
1980	851	19	$74.95	$129.95	$89.95	$89.98	$109.95	$144.90	$144.90	n/a
1981	855	45	$79.95	$134.95	$99.95	$99.95	NLA	$159.90	$159.90	n/a
1982	859	21	$89.95	$134.95	$99.95	$99.95	NLA	$169.90	$169.90	n/a
1983	863	20	NLA	NLA	$99.95	$99.95	NLA	NLA	NLA	$109.95
1984	867	54	NLA	NLA	$99.95	$99.95	NLA	NLA	NLA	$99.95
1987	208	18	NLA	NLA	$109.95	$109.95	NLA	NLA	NLA	$109.95
1988	211	27	NLA	NLA	NLA	$109.95	NLA	NLA	NLA	$109.95

TABLE II

is a Cinch-Jones, two-prong, chassis mount, male connector (Heath Part #432-31). A mating female cable connector (#432-30) was supplied with the kit. Figure 3 gives the Cinch Jones part numbers for these connectors. The wide blade/slot is the negative terminal and the narrow blade/slot is the positive terminal. The two power transistors are mounted on the rear panel to provide a heatsink. They mount in sockets and are insulated by covers. The connections to the screw terminal strip are shown in **Figure 4**. The connection to the speaker are terminals 1 and 2. Both are isolated from ground, so the speaker can be connected without polarity worries. One feature of the GD-18 is that it can be used in vehicles with either a



negative or positive vehicle ground. With this in mind, the siren may be activated by a remote switch, such as the car horn button [4], a foot switch [5] or any connection that can connect the correct terminal to vehicle ground. Terminal 3 is used with vehicles with a negative ground electrical system, and Terminal 4 is used with vehicles with a positive ground electrical system. In either case the unused terminal should remain isolated. Terminals 5 and 6 are for the radio audio. They can be connected in parallel with the wires to the radio speaker. Terminal 5 is the input terminal, and terminal 6 is an "isolated" common input connected to the siren common through a 10 µF 150 V electrolytic isolation capacitor.

The GD-18 Accessory Speakers (Horns):
Heath sold two speakers for use with the GD-18 siren. The GDA-18-1 horn speaker **(Figure 5)** that mounts atop the vehicle, or on a fender. This speaker came completely assembled; it is not a kit. Specifications for the GDA-18-1 are given in **Table IIIA**. The other speaker **(Figure 6)** is the GDA-18-2 and comes as a kit. It is designed to be mounted, concealed, under the hood, behind the grille. The kit comes with a pair of mounting brackets Specifications for the GDA-18-2 are given in **Table IIIB**.

Figure 5: The GDA-18-1 Fully Assembled External speaker for the GD-18 Siren. The speaker usually mounts on the top of a vehicle.

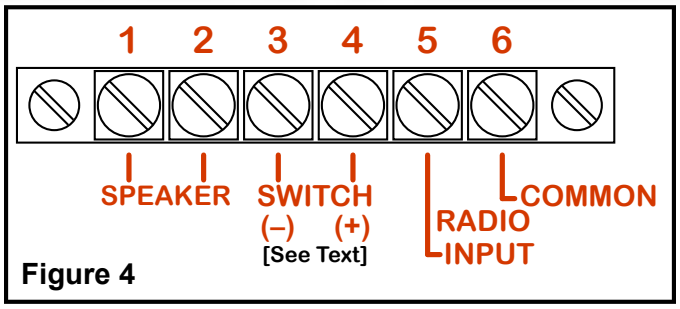


Figure 4

The GD-18 and GDA-18-2 Kit Assembly:
The GD-18's single circuit board is assembled first. It holds most of the components for the GD-18 Siren, including the GAIN pot (which is mounted to the board using a control spacer), the FUNCTION switch, the two set-and-forget trim-pots and the lamp that edge lights the front panel. All the components that mount on the board are installed except the two driver transistors (Q10 and Q11) which will mount later.

The rear panel 'backplate' is assembled next. It holds Q12 and Q13, both socketed, the fuse

GDA-18 1 SIREN HORN SPEAKER SPECIFICATIONS

Mounting:	External on Vehicle.
Assembly:	Fully Assembled.
Impedance:	16 Ω nominal.
Frequency Range:	275 to 8000 Hz.
Sound Level:	128 dB (measured 4' on axis, at rated power).
Dispersion:	100 Degrees.
Peak Power Rating:	75 Watts.
Dimensions:	8 ¾" Dia. x 8 ⅞" High x 8 ⅞ Long.
Mounting Base:	Sandcast aluminum for vandal-proof, concealed connections
Finish:	Alodine* corrosion proofed and painted with special gray melamine enamel
Net Weight:	7 lbs.

*™Amchen Products, Incorporated

TABLE IIIA

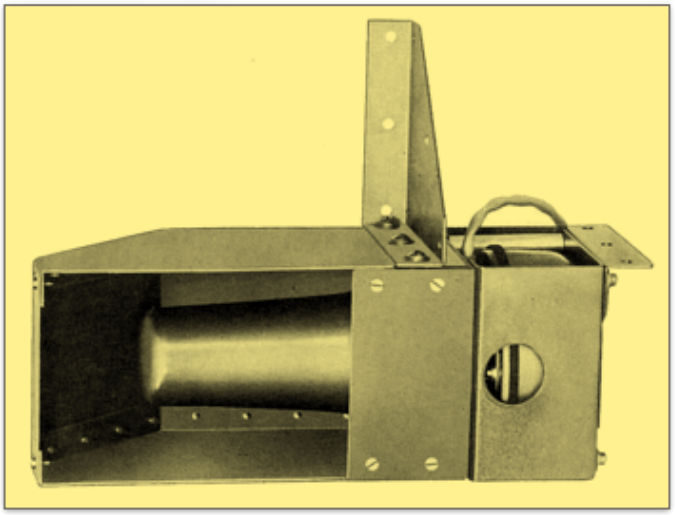


Figure 6: The GDA-18-2 concealed speaker kit for the GD-18 Siren. This speaker can be mounted using none, one or two of the supplied brackets. (Two bracket mounting configuration is shown) The speaker is mounted behind the grille, using one of numerous configurations discussed in the manual.

holder, power connector and the six-screw terminal strip. The two temperature compensating diodes D3 and D4 mount in-between the power transistors in clamps that hold them firmly against the backplate. A 3-lug solder terminal strip, mounted with one of the clamps, provides tie points for the diode leads, the 5 watt emitter resistor (R44) for the transistors and two capacitors (C8 and C21) that need to be near the screw terminal strip.

A short eight-conductor cable is then used to connect the circuit board to the backplate.

The cabinet bottom is prepared next. Stick-on rubber feet are added as are grommets for the trimmer adjustment holes. Then the side plates are added, along with the hardware to mount the gimbal bracket. A foam square to support the circuit board is added to the bottom panel.

Front-plate assembly is then started. The end of the microphone cable is prepared, the front-plate is mounted to the side plates of the cabinet bottom assembly, and the microphone cable is attached to the front panel with a cable strain relief. A twisted pair of wires are added

GDA-18 2 GRILLE SIREN SPEAKER SPECIFICATIONS

Mounting:	Concealed behind grille.
Assembly:	Requires assembly.
Impedance:	16 Ω nominal.
Frequency Range:	300 to 3000 Hz.
Sound Level:	Dependent on mounting position.
Dispersion:	Dependent on mounting position.
Peak Power Rating:	75 watts.
Dimensions:	4 ½" square by 12 ¼ long (excluding mounting brackets).
Finish:	Driver and center section Alodine* corrosion proofed and painted with special gray melamine enamel.
	Sheet metal parts corrosion treated and painted with gunmetal-gray baked enamel.
Net Weight:	8 lbs.
	*™Amchen Products, Incorporated

TABLE IIIB

to the MANUAL pushbutton switch. The circuit board is laid horizontally in the cabinet bottom, foil-side up. The wires from the pushbutton and the microphone cable are then soldered to the circuit board. The pushbutton is then mounted to the front-plate.

Next, the output transformer is mounted to the cabinet bottom, and its leads are soldered to the backplate and circuit board. A heatsink is prepared by mounting the two driver transistors (Q10 and Q11) to it using insulating hardware. The assembly is then placed in the holes provided on the circuit board, but not soldered yet. The complete circuit board is now mounted to the front-plate, using control hardware. The driver heatsink is bolted to the cabinet bottom (**Figure 7**), and the driver transistors are then aligned and soldered to the circuit board.

The plastic front panel is installed next by removing the existing control hardware, placing

the panel over the shafts and then carefully replacing the hardware so as not to damage the plastic panel. The front panel knobs are added. Then the backplate is attached to the side panels, and the 8-conductor cable between the backplate and circuit board is neatly secured with two cable clamps. This completes the assembly of the GD-18 except for the top cover which remains off during initial tests.

With the GD-18 put aside temporarily, the power cable for it is assembled.

GDA-18-2 Speaker Kit Assembly:
The assembly of the concealed speaker is mechanical, except for the speaker cable. Initially, one end of the speaker cable supplied with the kit (#16 gauge 2-conductor) is prepared and connected to the speaker driver. Then the enclosure assembly is screwed together using sheet metal screws. The manual then recommends the other parts and brackets be taken to the car, configured to each of the mounting configurations in turn, selecting the one that fits best. The speaker is then mechanically built to that configuration, and the correct drill template is selected from the manual and used to drill the mounting holes in the vehicle. Once installed, the speaker wire is routed to the GD-18 Siren and then lugs are soldered to the end of the speaker cable and connected to the GD-18 rear terminal strip.

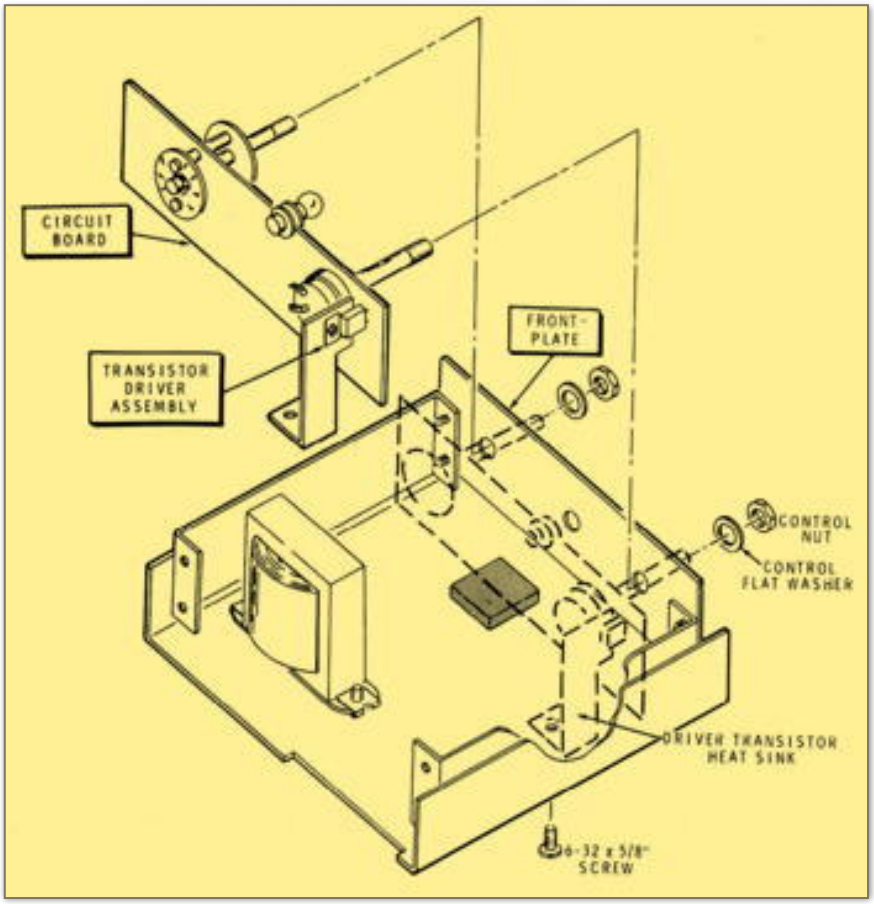


Figure 7: Installation of the circuit board with driver heatsink.

GD-18 Circuit Description:
Figure 8 is a block diagram of the GD-18. It can be broken down into the 5 Blocks shown:

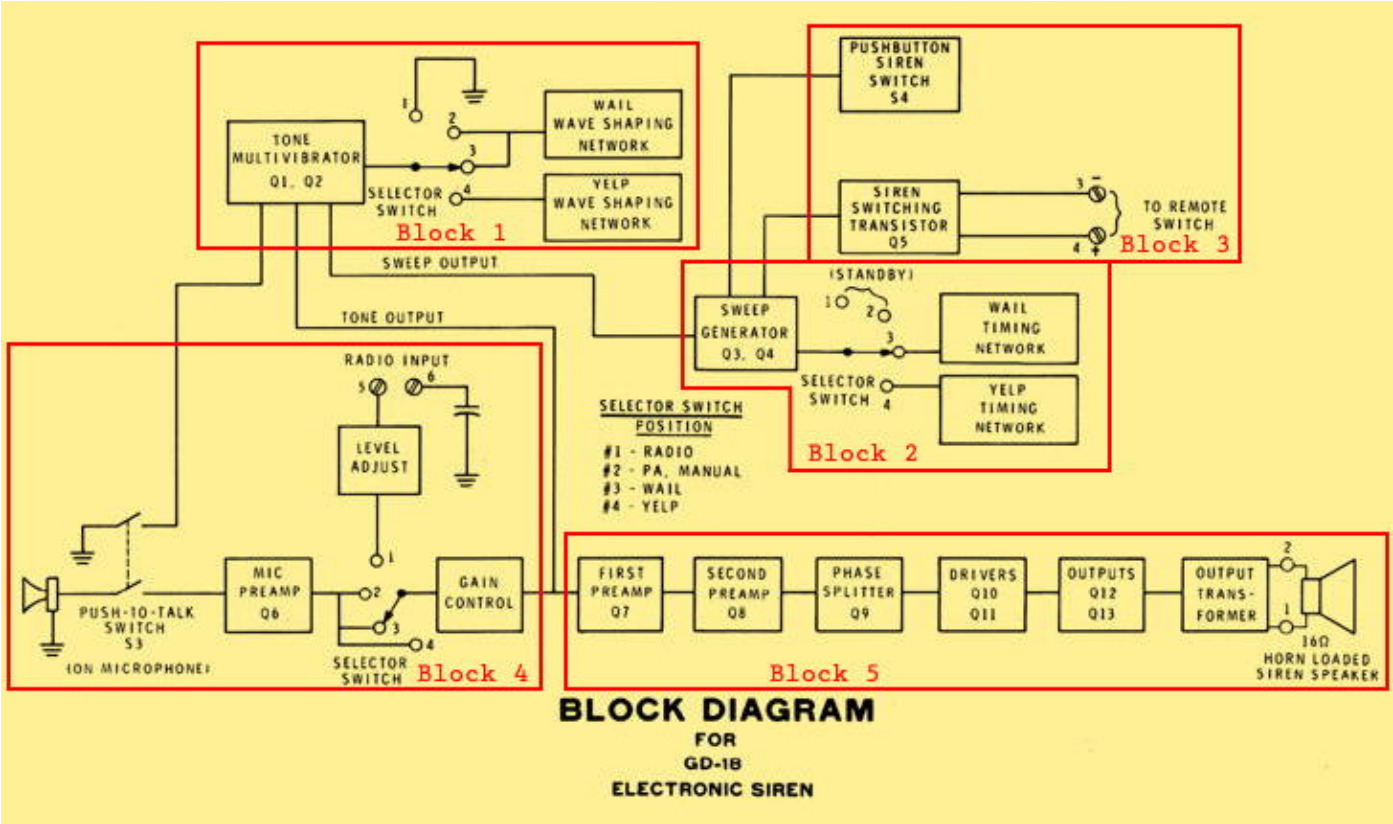
1. **Tone Multivibrator** for wail and yelp sounds.
2. **Sweep Generator** for wail and yelp timing.
3. **Siren Switching Circuits.** for local and remote activation.
4. **Mic Preamp and Radio Input Circuit.**
5. **Audio Amplifier** that drives the speaker.

These sections are outlined and numbered in the block diagram. A schematic is too large to include, but an easily readable one is available online (Scroll right on page 4):

https://www.w6ze.org/Heathkit/HeathSpecSheets/AUT/GD-18%20[596-1189-06]%201970.pdf

Table IV Lists the GD-18 semiconductors and their purpose. Q10 and Q11 were changed early on to the Texas Instruments TIP31B.

Tone Multivibrator (Block 1):
Zener diode D5 and R20 make-up a simple 9V voltage regulator that powers the tone multivibrator and sweep generator circuits, and isolates them from vehicle power fluctuations.



Q1 and Q2 make up a simple multivibrator that creates the basic tone used in the siren. Collector voltage is supplied through R11 and R12. R12 is adjustable to set the center tone for the multivibrator. Bias for both Q1 and Q2 is provided at the junction of R6 and R7. When the SELECTOR switch is in the RADIO position, or the mic PTT is pressed, or Q4 is cutoff, no bias is provided to the multivibrator and it is off. When bias is provided, the multivibrator will produce a tone at a frequency dependent upon the bias voltage. Output from the multivibrator is connected to the input of the first preamplifier Q6, through R1 and C1.

Sweep Generator (Block 2):

The sweep generator modulates the multivibrator tone to give it the unique wailing or yelp sounds. Q3 and Q4 are the active components. When the FUNCTION switch is in the PA or RADIO positions, R17 shunts R18 lowering the emitter resistance of Q3 substantially, turning on Q3. Q3, in turn, turns off Q4. As mentioned earlier, this prevents the multivibrator from running; it also prevents the sweep generator from operating.

When the FUNCTION switch is moved to the WAIL position resistor R17 no longer shunts the emitter resistor of Q3, and it turns off, causing Q4 to turn on and C5 to begin charging up. As it charges, the voltage at the junction R6 and R7 begins to increase bias to the tone multivibrator, turning it on and increasing the tone frequency as the C5 charges. At the same time, C7 begins to charge through R18. As C7 charges its voltage rises and the emitter voltage across R18 decreases [6]. When the voltage goes low enough, Q3 turns on, turning off Q4 which starts C7 discharging, raising the emitter voltage. Q5 also starts discharging reducing the bias and lowering the tone. This continues until Q3 turns off, completing the cycle. The voltage created across C5, as it charges and discharges, varies the frequency of the tone oscillator. C7 sets the sweep cycle rate.

When the FUNCTION switch is in the YELP position, C5 and C7 are replaced by C4 and C6, changing tone and timing and creating the faster YELP sound.

Siren Switching Circuit (Block 3):
When the FUNCTION switch is in the PA position the siren may be activated by either the MANUAL pushbutton (S4) or by an external switch wired to the proper SIREN SWITCH terminal on the six-screw-terminal strip on the back of the unit [7].

Pressing the MANUAL pushbutton applies a voltage to the base of Q4 turning it on and activating the siren.

On a vehicle with a positive ground electrical system, a remote switch that connects terminal #4 to ground will also apply a positive voltage to the base of Q4 turning it on and activating the siren.

On a vehicle with a negative ground electrical system, a remote switch that connects terminal #3 to ground will turn on Q5 which will apply a positive voltage to the base of Q4 turning it on and activating the siren.

Mic. Preamp & Radio Input Circuit (Block 4):
When the FUNCTION switch is in any position except RADIO, and the mic button is pressed, the mic is connected through C9 to Q6 and the mic red wire is grounded, removing the bias on the multivibrator, silencing the siren immediately if it is running. The audio from the mic is amplified by the mic preamp (Q6), and sent to the GAIN control. C10 and C11 reduce the preamp gain at the higher frequencies to help prevent acoustic feedback.

Audio from the vehicle's 2-way radio is connected to the rear terminal strip of the GD-18. The hot audio lead is at terminal #5 and the neutral lead is at terminal #6. Terminal #6 is connected to common in the GD-18 through a 10 µF electrolytic capacitor for DC isolation (needed on positive ground vehicles). The hot audio is attenuated by C13 and C14 and the RADIO INPUT LEVEL ADJUST pot.

When the FUNCTION switch is in the RADIO position, audio from the radio replaces audio from the mic, allowing it to be played through the amplifier and siren speaker.

GD-18 SEMICONDUCTORS

Q1	2N3393	Tone Multivibrator
Q2	2N3393	Tone Multivibrator
Q3	2N3393	Sweep Generator
Q4	2N3393	Sweep Generator
Q5	X29A829	Negative Ground Remote Switch
Q6	2N3393	Microphone Preamplifier
Q7	2N3393	First Preamplifier
Q8	2N3393	Second Preamplifier
Q9	2N3393	Phase Splitter
Q10	2N5294/TIP31B	Driver Follower
Q11	2N5294/TIP31B	Driver Follower
Q12	MHT9210	Power Amplifier
Q13	MHT9210	Power Amplifier
D1	1N4149	Bias & Negative Clipping
D2	1N4149	Bias & Negative Clipping
D3	1N3754	Temp. Compensating bias
D4	1N3754	Temp. Compensating bias
D5	VR9.1	Voltage Regulator for Q1 through Q4
D6	1N4149	Protection for Q5

SEMICONDUCTOR INFORMATION

2N3393	(417-118) NPN Si Gen. Purpose Fairchild V_{CEO} 25V, I_C 500 mA, P_D 625 mW, $ß_{MIN}$ 80
X29A829	(417-201) PNP Si Gen. Purpose G.E. V_{CEO} 50V, I_C 500 mA, P_D 330 mW, $ß_{MIN}$ 120 Substitutes: 2N3906, D29A4 (T.I.)
2N5294	(417-175) NPN Si Med. Power, NJ Semi. V_{CEO} 40V, I_C 4 A, P_D 36 W, $ß_{MIN}$ 25, 1.2 MHz
TIP-31	(417-852) NPN Si Med Power, T.I. V_{CEO} 40V, I_C 3 A, P_D 40 W, $ß_{MIN}$ 75, 3 MHz
MHT9210	(417-162) NPN Hi Power, TO-5, Solatron V_{CEO} 30V, I_C 15 A, P_D 115 W, $ß_{MIN}$ 20 Substitute: 2N3055

TABLE IV

Audio Amplifier Circuit (Block 5):
Output from the GAIN control connects to two stages of pre-amplification by Q7 and Q8. The siren tone from Q1 bypasses the gain control and is coupled directly to the base of Q7. The collector of Q8 is directly coupled to Q9, the phase splitter. The siren signal is higher voltage than the audio and gets clipped into a square wave. during amplification. The signals at the collector and emitter of Q9 are basically identical, except they are 180° out of phase with each other. Q10 and Q11 drivers are wired as emitter followers and provide current gain to drive the output transistors Q12 and Q13. Bias for the driver and output stage is through R41 and is regulated by D3 and D4. D1, D2, R39 and R40 distribute the bias. R44 provides additional emitter bias. Diodes D3 and D4 are located in proximity to Q12 and Q13 to also provide thermal stability by changing the bias in relation to the temperature.

Q12 and Q13 drive T1 and provide 16 Ω output to the speaker.

Some Heathkit humor forwarded to me by John - K7KF

Comments:
For the past several years, in honor of April Fools' Day, the April subject is often one of the more unusual Heathkits sold. My favorite is the HeathCraft candlesticks [8]. This year, when I saw the GD-18 Electronic Siren, it was chosen. Little information was available other than the specification sheet and what could be gleamed out of the catalogs. It was going to be a short article, but a parts list was needed so an email went out. Within a day I had parts lists from the -10 and -15 manual editions as well as a full pdf of the -10 manual [9]. So much for a short article.

While laws vary by state, one has to doubt a siren can be legally used in a private vehicle by a common citizen. And further, It is hard to believe police departments, and fire and ambulance companies would be purchasing kit sirens. Initially, factory assembled models were not available. Having lived in restriction-heavy California for 60 years I couldn't grasp who was buying these kits. Retired Heathkit Executive Vice President, and General Manager Chas Gilmore - W8IAI kindly replied to my query:

Bob,

At the time the market was to volunteer fire and police auxiliary. I believe in mostly rural areas where volunteers made up significant portions of departments. They had authorization to use sirens and light bars on their personal vehicles when responding to an emergency. If they had such equipment, it was at their own expense (I think some departments would reimburse [-] *partially or fully in some cases). I'm not sure when this practice was discontinued. They were good products in the 1970s and discontinued by the* [late] *1980s.*

Chas

Having lived in suburbia most of my life; I forgot about rural volunteer fire departments and police auxiliaries. Googling "sirens in private California vehicles", revealed no definitive answer on the legality in the State. The search results quickly diverged to commercial entities that serve the whole country. However, states with a lot of rural areas, evidently allow sirens and lights on civilian vehicles associated with sanctioned volunteer services.

In numerous states the law doesn't allow a vehicle to use its siren unless it is also showing flashing lights. The later GD-1810 had an accessory light relay for this purpose: The GDA-1558–1 Emergency Lighting Relay ($4.95).

There is a YouTube video[10] that shows the GD-18 in action on the bench. The siren sounds as good as one on any California emergency vehicle.

New Heath Spec. Sheet Site:
Check out the Heathkit Specification Sheet page[11] on the W6ZE website. It currently contains 157 sheets in 15 categories. More are being added as time allows. It is still in beta, but is quite useable. Most of the schematics are very readable when enlarged.

73, from AF6C

Notes:

1. More on the use of this product in the comments section of the article.
2. See HotM #123: https://www.w6ze.org/Heathkit/Heathkit_123_CI1080.pdf
3. GD-18 Fuse: OEM part #421-9 **Buss** MDX-7 (125 V),
   or substitute **Littelfuse** 3AG 313 007 (250 V)
4. Detailed wiring instructions are included in the manual for both positive and negative ground vehicles.
5. ibid.
6. This description is different than the one presented in the Circuit Description section of the -10 manual.
7. The MANUAL button, when pressed, will cause the tone to rise continually as long as it is held, up to its limit. When the button is released the tone will lower until it stops. If the button is pushed again while it is lowering, it will start to rise again.
8. See HotM #123: https://www.w6ze.org/Heathkit/Heathkit_039_F2587K.pdf
9. The following people contributed to this article:
   Chas Gilmore - W8IAI, Steve Gladstein - N8FH,
   Chuck Penson - WA6ZZE, Santos e Silva,
   Dan Viloette - KI6X
10. https://www.youtube.com/watch?v=63vED485Eq4
11. https://www.w6ze.org/Heathkit/HeathSpecSheetsIndex.html

Heathkit®

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

Thanks - AF6C