Heathkit of the Month #112:
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AMATEUR RADIO - SWL

Heathkit SB-634
Station Control Console.

Introduction:

From 1966 until 1974 Heathkit produced the SB-630 station console that combined an SWR meter, phone patch, clock and 10 minute timer into one package (See Heathkit of the Month #107)[1]. This console was designed to match the early SB-line of amateur radio equipment[2]. When Heathkit came out with the newly styled SB-104 transceiver in 1974, they also introduced the SB-634, an updated version of the SB-630, to match the new styling[3].

The SB-634 features the same basic functions with some significant improvements: The SWR meter has been replaced with a combination SWR and power meter based on the HM-102, discussed in detail in HotM #54[4]. The clock is no longer a mechanical digital-clock, but a true electronic digital clock. And, the 10-minute timer is a true digital timer with a three-digit readout. The phone patch is an improved version of the Heathkit HM-15 hybrid phone patch[5].

The SB-634 Overview:

The SB-634 comes in a larger cabinet than the SB-630, measuring 7¼"H (½" higher), 10¼"W (¼" wider) and 15¼"D (4¼"deeper); this is the same depth as the SB-614 monitor scope and the SB-644 external VFO – other accessories made for the SB-104(A).

FIGURE 1: The Heathkit SB-634 Station Console. A combination SWR Meter, Dual Range RF Power Meter, Ten Minute Timer and Phone Patch.

The front panel includes a large analog meter that may be switched to measure SWR or RF power 200W/2,000W, as well as VU-level for the phone patch (See **Figure 2**). The meter is also used as a null indicator for adjusting the hybrid phone patch balance. Behind a thick red plexiglass plate sits the clock time indicator consisting of three Beckman "Panaplex" SP352 neon two-digit, 0.55 inch high, numerical displays that show the hours, minutes and seconds. There is a gap between the minutes and seconds display; no colons are used. To the left of the clock display is the 10-minute timer display. When activated it displays three digits 0.305 inches high displaying 0–9 minutes and 0–59 seconds. The front-panel controls are shown in **Table I** and the rear connections and controls are shown in **Table II** and **Figure 3**.

When the SB-634 was released in late 1974, it sold for $179.95. The recently discontinued SB-630, that the SB-634 replaced, was selling for half that, $89.95, in the March 1974 catalog. The SB-634 Station Console continued to

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 14

Heath SB-634 Front Panel

Top Left: Meter 0–100 µA, (meter resistance not given):

R.F. POWER: 0 to **2000** watts full scale.
R.F. POWER: 0 to **200** watts full scale.
SWR: 1 to **3** (at center scale) Set line at full scale.
VU: **-20. to +3** db. Wide white arc 0 to +3 db.
Figure 2 shows the meter scales.

Bottom Left (Below meter) Bank of 5 pushbutton switches

FORWARD IN / REFLECTED OUT independent switch.

(The following switches are ganged meter switches)

SWR.
2000W meter scale (POWER).
200W meter scale (POWER).
VU / PATCH Sets the meter to measure VU and switches in phone patch circuit..

Top Right: timer and clock displays (see text).

Bottom Right, Top Row:

TIMER (three position rotary switch):
OFF, VISUAL, AURAL VISUAL

PATCH GAIN (dual concentric potentiometers):
XMTR level (outside), 200 KΩ / 1500 Ω dual pot (Hi-Z output and 600 Ω output respectively.)
RCVR level (inside) 10 Ω potentiometer

SWR (potentiometer):
Marked **MIN** (ccw) and **MAX** (cw) at pot ends.

Bottom Right, Bottom Row:

Timer **RESET** (momentary pushbutton - red)

IDENTIFY (Lamp - #49 bulb - 2.0V 60 mA - w/green lens)

TABLE I

FIGURE 2: Heathkit SB-634 Meter reads Power (0–200 or 2K watts), SWR, and Phone Patch VU. The meter is not illuminated.

Heath SB-634 Rear Panel
(Refer to Figure 3)

Top to Bottom, Left to Right:

First Column:

Clock Setting Switches (Momentary slide type):
TIME HOLD
MINUTES SET
HOURS SET

Phone Patch **NULL ADJUST:**
Potentiometer, 2 KΩ, Screwdriver adjust

Phone Patch **PHONE LINE** terminals:
Jones type barrier strip, two terminal, no polarity marks

Second Column:

Phone Patch Meter Switch:
Slide With, 2-positions -**NULL, MONITOR** VU
(Switch normally remains in MONITOR position.)

Connector Strip, 4 RCA jacks (L to R):
To **SPKR**.
Speaker audio rom **RCVR**
600 Ω audio to transmitter
HI Z (high impedance) audio to transmitter.

Third Column:

RF OUTPUT, SO-239 UHF connector
Mating connector is PL-259 UHF plug.

RF INPUT, SO-239 UHF connector
Mating connector is PL-259 UHF plug.

Fourth Column:

Two Access holes for Power SWR adjustments
Hole '**C**' for SWR null adjustment capacitor C304
(Marked SWR NULL on schematic.)

Hole '**R**' for RF power calibration pot R307
(Marked CALIBRATE on schematic.)

TABLE II

sell until it was discontinued in 1983. In mid 1982 it was selling for $194.95, but with the phaseout of the SB-104A transceiver, Heath, in their Christmas 1982 catalog, was offering it at $99.95 ("…save $95.00.") See **Figure 4**.

The phone patch and SWR/Power circuits require no AC power and will work properly when the SB-634 is unplugged. When plugged in, the clock immediately comes on, but the 10-minute timer can be turned on or

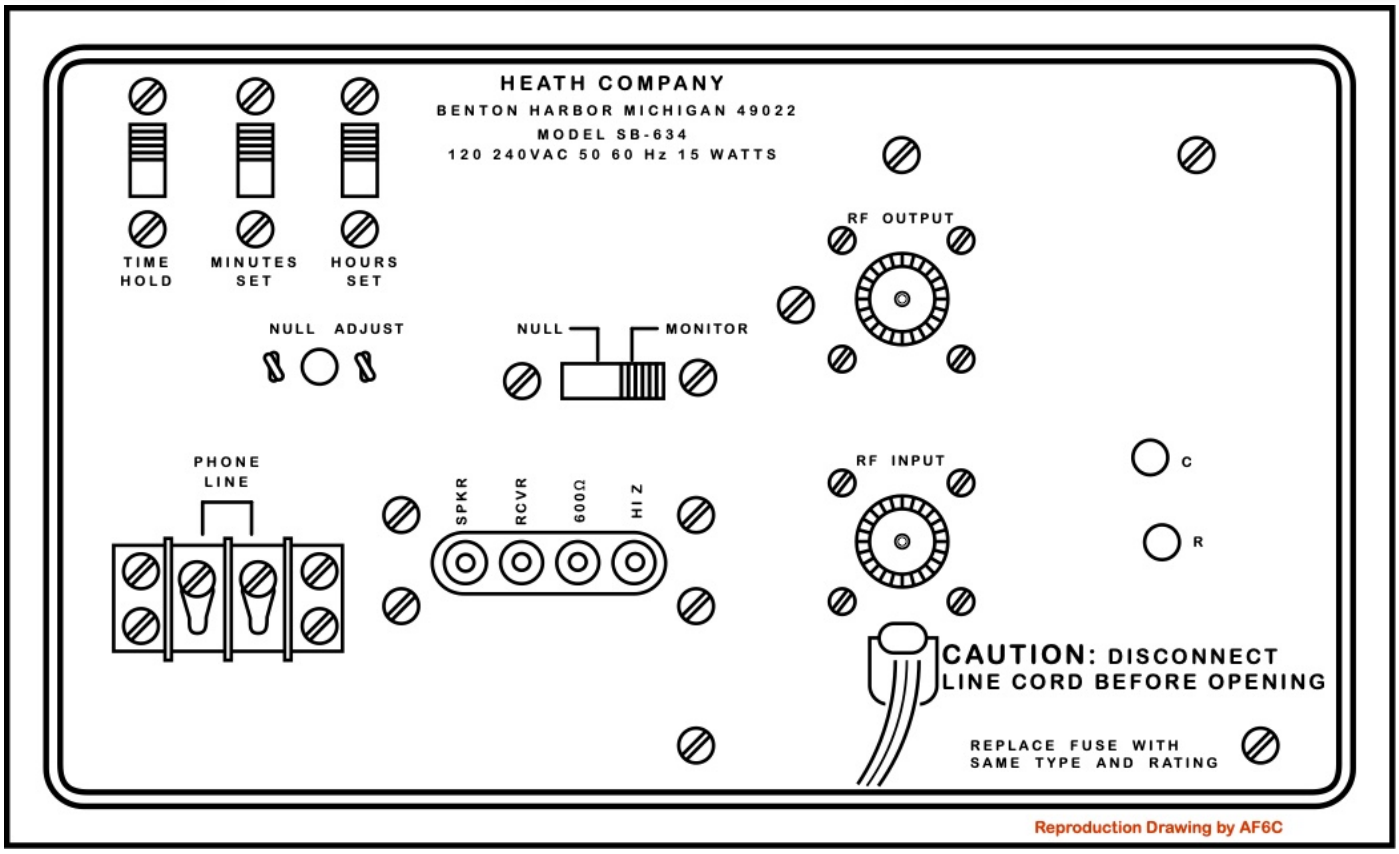


FIGURE 3: Heathkit SB634 Rear Panel Layout (Refer to TABLE II)

off by the rotary front panel **TIMER** switch. The SB–634 is compatible with 120 or 240 VAC, 50 or 60 Hz power. It draws a maximum of 15 watts[6].

The Heathkit SB-634 may be divided into five functions, four functions if the SWR bridge and power meter are combined. We will look at them individually.

The 24 HOUR CLOCK:

Heathkit relied heavily on their design of the GC-1005 digital alarm clock for the clock used in the station console. They both use the Mostek MK5017AA alarm clock integrated circuit. The Heath part number changed from 443-601 to 443-687; originally the chips were hand selected to solve a flicker problem, but when Heath engineers solved the flicker problem, they no longer needed to hand select the chips, hence the new part number. In the SB-634, Heathkit upgraded the clock display from the SP-752 to the SP-352 with a built-in keep-alive anode which Heath ended up not using. The displayed numbers are a little over one-half inch high (0.55") and


4 **NEW SAVINGS on Station Console**

You can save $95.00! Five-function Console features 24-hour, 6-digit clock; 10-minute ID timer w/auto reset; RF watt-meter w/200/2000 watt ranges; SWR bridge w/sensitivity control; manual/VOX-controlled phone patch. Phone patch provides at least 30 dB isolation. Input impedance is 600 ohm. 1.8 to 30 MHz. 120/240 VAC.

Kit SB-634, 13 lbs. **WAS $194.95, NOW 99.95**

HDZ-63-3, 3-ft Coax w/conns., 1 lb. **4.95**

FIGURE 4: Discount ad for the SB-634 in the 1982 Xmas catalog - close to 50% off. That price remained until mid-1983 when the station console was discontinued.

bright enough to be seen in bright daylight. The SB-634 clock is hard-wired for a 24 hour display with no published option for 12 hour operation. However, the removal of D205 will allow 12 hour operation, but without any AM PM indication.

The clock accuracy is based on the power line frequency. Which in the 60's and 70's was better regulated than it is today. Hence the clock accuracy can vary significantly over a period of a few days. Operation in countries where the power line frequency is 50 Hz. requires only the addition of a diode in the open holes marked D204 on the main circuit board. D204 (1N4149) was supplied with the kit.

Setting the clock is done using three momentary slide switches located on rear panel. They are, somewhat misleadingly, marked as **TIME HOLD**, **MINUTES SET** and **HOURS SET.** TIME HOLD resets the seconds to zero and the seconds don't start counting until it is released. MINUTES SET causes the unit minutes digit to increase. When held, the digit increases by one each half-second up to nine and then back to zero without incrementing the left minutes digit. The HOURS SET operates as expected, incrementing the hours from 00 to 23 each half-second before cycling back to 00. To set the left minutes digit both the MINUTES SET and HOURS SET must be held simultaneously. This will cause the tens of minutes display to increase 0 to 5 before returning to zero and staring over.

Figure 5: The Heathkit SB-634 Console

Why Heathkit didn't incorporate a simple crystal oscillator for the timebase was probably a matter of cost. Though it would have made a good extra-cost option. The clock has no battery backup, and any significant interruption will cause the clock display to show all eights until reset.

With today's PIC computer-on-a-chip, and low cost GPS time receivers, it probably wouldn't be too hard to convert the clock to one of high accuracy. Some sort of external GPS antenna would be needed.

When plugged in, the clock display is on continuously. There is no way to dim or turn off the display without stopping the clock. However the display is not so bright that it would be annoying to someone trying to sleep in the radio room.

The TEN MINUTE TIMER:

FCC Part 97.119(a) requires that an amateur station identify, at a minimum, once every 10 minutes. A simple, resettable, 10 minute timer can aid in obeying this rule for people "rag-chewing" or involved in some net operations. The SB-634 has such a timer built in.

To the left of the time display is a three-digit display that is not visible when the **TIMER** switch is in the **OFF** position. Moving the TIMER switch to either the **VISUAL** or **AURAL** - **VISUAL** position causes the display to show with a random pattern. Pressing the **RESET** button resets the display to 000, and it starts counting each second in sync with the clock. The two right-hand digits represent seconds and each time they advance from 59 they go to 00 and the left-hand digit, representing minutes, is incremented. When the count advances from 959 it goes to 000 and the green **IDENTIFY** light illuminates for approximately a second. If the TIMER switch is in the AURAL VISUAL position a tone is also heard from the built-in speaker while the IDENTIFY light is lit. The RESET pushbutton can be operated at any time, reseting the timer to zero. This allows one to reset the timer whenever they identify prior to the full ten minutes.

The SWR and POWER METER:

Except for the meter switching, that allows the meter to be used also for the phone-patch functions, the circuitry and components are the same as found in the Heathkit HM-102 with few exceptions. The printed circuit boards are identical except for the component silkscreening, and hold the same components. The pickup coil is identical down to the eyelet that holds it in place. While the **'C'** trimmer capacitor is marked with slightly different values, they have identical part

Figure 6: Heathkit SB-634 showing smaller timer digits left of the time digits. 144 (1 minute 44 seconds into the 10 minute period.)

numbers. The front panel **SWR SENSITIVITY** control is 250 KΩ instead of 200 KΩ and lacks the pull switch function of the HM-102, which, in the SB-634, is incorporated into the switch bank below the meter. The change in value has little effect on the SWR bridge operation and was probably selected as it was a common part used in over a dozen other Heathkits. The sensing element for the SB-634 SWR Power Meter is built into the chassis and cannot be located externally like the HM-102 allows. As previously mentioned, the HM-102 was discussed in detail in HotM #54. Refer to that article for its operation and circuit description.

The HYBRID PHONE PATCH:

Like the Clock and the SWR Power Meter covered above, the Hybrid Phone Patch is based on an earlier stand-alone kit - the HD-15 which was an improved (and less expensive) version of the earlier HD-19. A significant part of the lower cost was Heathkit finding a good quality but less expensive hybrid transformer set. This set continued to be used in the SB-634. The HD-15 was also featured in an earlier article.

What makes a phone patch hybrid is its ability to keep the audio coming from the receiver from being fed to the transmitter. This capability allows VOX operation. It is accomplished by a bridge circuit that nulls out the audio being fed to the transmitter while letting it pass to the phone line.

Unlike the HD-19 which only has a Hi-Z mic impedance output, the HD-15 and SB-634 also have a low 600 Ω mic impedance output, making them compatible with most transmitters, old and new.

New in the SB-634 phone patch is what is sometimes referred to as a 'Cap'n Crunch' filter. This filter blocks any audio around 2.6 KHz., that might be created by a heterodyne, from reaching the phone line. This is a tone used by the phone company to signal on long distance calls that the party on the other end of the line has dropped the connection. The filter got the name from the plastic bosun's whistle included as a kid's toy in boxes of Cap'n Crunch cereal in the late 1960's. The whistle could create a precise 2.6 KHz tone, and "phone phreaks", used the whistle to hack the phone system. (See Sidebar).

Assembling the SB-634 Station Console:

Assembly of the SB-634 is done in four sections. First, three printed circuit boards are populated with parts: the Power Meter Circuit Board, the Main Circuit Board and the Display Circuit Board; then the Chassis is assembled and the circuit boards wired in. Near the end of assembly, testing and adjustments are done before the final assembly is completed.

The heart of the passive Power Meter Circuit Board is a small toroid transformer that is inductively coupled to the transmission line. Two small capacitors provide the capacitive coupling. The circuit board sits in a shielded enclosure. On the HM-102 a slide switch selects NORMal operation or CALibrate. In the SB-634 the switch has been replaced with a movable soldered jumper. Though the two power meter calibration adjustments are accessible through holes in the rear panel, the cabinet and the top shield must be removed to access the jumper (See **Figure 7**). Parts mounted on the power meter board have numbers in the 300s (R301, R302, etc.)

The Main circuit board contains 5 socketed ICs including the MK5017AA clock chip, 19 transistors, (Q214 mounts with a heatsink), 7 rectifier diodes, 9 signal diodes and 2 zener

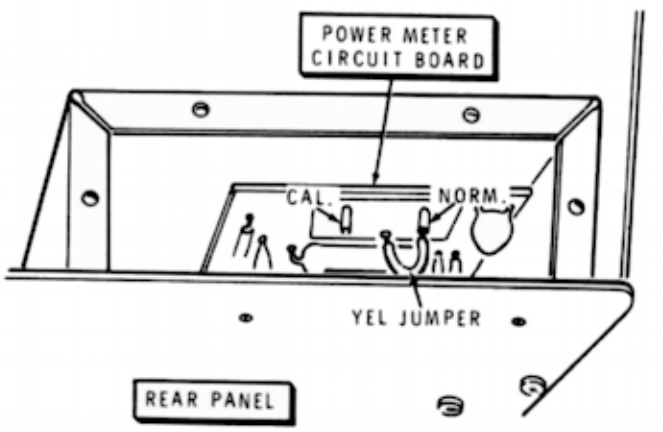


FIGURE 7: Access to the power meter CALibrate jumper is accessible after removing the shield top with the SB-634 removed from its cabinet.

diodes. with supporting resistors (46) and capacitors (18). Also mounted on the board is the IDENTIFY lamp and timer RESET momentary pushbutton switch. Numerous ribbon cables, single wires and one end of a five conductor round cable are soldered to the main board. Those wires that will be attached to the display board (29) have a bullet connector attached at their open end. Components mounted on this board have part numbers in the 200s.

Next, the Display Board is assembled. It holds 33 resistors, 3 socketed ICs, 3 socketed 2-digit displays and one socketed smaller three digit display. To ease alignment of the 16-pin clock displays, individual sockets are installed on each display pin and then the whole assembly is installed on the board and the sockets are soldered to the board. the timer three digit display has a complete display socket.

With the boards completed, wiring of the chassis begins. The phone patch circuitry does not use any of the circuit boards and is hand-wired during chassis assembly. Once the chassis parts are mounted initial wiring that doesn't go to a circuit board is completed. Next parts are installed on the rear panel and initial wiring is done as above. Next the power meter board is mounted to the rear panel, wired and its shielding installed. The rear panel is then mounted to the chassis and wired up. Next, components are mounted on the front panel; it is then mounted to the chassis and also wired in. The meter, which mounts on a bracket to the chassis side is installed and connected.

Now the display board is mounted to the front panel and the main circuit board is mounted and wired to the chassis. The ends of the ribbon cables from the main board are plugged into the display board, the line cord is connected and knobs and trim are installed.

TESTS & ADJUSTMENT:

With the TIMER switch **OFF** the SB-634 is plugged in. The clock digits should illuminate showing 8888 88. Pushing down on the **TIME HOLD** switch should cause the digits to display 0000 00, and when released, the seconds should begin counting. Next the setting functions are checked one at a time. With the clock working properly, the timer is checked next. It is turned on and RESET is checked. then the timer is allowed to proceed the full ten minutes and the IDENTIFY lamp and aural signals are confirmed.

Adjustment of the SWR balance is accomplished using a 50Ω dummy load, applying forward power at a convenient level and then using the "C" hole in the back to adjust the reflected power to zero. This is repeated as the power is increased until a good null is reached.

Heathkit offers three ways to calibrate the power function. The first uses a built in calibration circuit and requires a 40 meter signal. Once calibrated at 40 meters the calibration is good across the other HF bands. See HotM

#54 for more on this procedure. Calibration may also be done on a band other than 40 meters. It requires an RF voltmeter, or VTVM with an RF probe, to complete. Finally, a third way to calibrate the meter is given using a known calibrated power meter such as a Bird 43 wattmeter with appropriate slug.

CIRCUIT DISCUSSION:

Power Meter & Phone Patch:
The HD-15 Phone Patch and HM-102 Power Meter have been discussed before (Refer to the appropriate HotM articles for any discussion.)

Power Supply:
To run the clock and timer circuits a multiple output power supply was designed. The 120V/240V primary transformer has three secondary windings. The first winding produces 18 VDC after half-wave rectification, filtering and regulation by a 1N4166 18V 1W zener diode. This powers IC201, the clock chip. This winding is also separately rectified and fed to a voltage divider to provide a 0–14.5 volt half-sine wave to the 50/60 Hz clock chip input. Noise is filtered from this line with a 0.022 µf capacitor. This is the signal on which the clock bases its time. The second winding uses a half-wave rectifier and a C-R-C filter to produce +230 VDC for the display tubes. The third winding is full wave rectified and well regulated to provide +5 volts to the TTL ICs for the 10-minute timer.

24 Hour Clock:
Each of the six digits in the clock display have one anode lead and seven cathode leads. Each anode lead is connected to a voltage tapped down from the 230 V supply. This voltage is not enough to ionize the gas in the display tube but provides faster ignition. The clock is continually selecting, in sequence, one of the anodes, illuminating that digit. At the same time, the clock chip is activating the proper cathodes of the display digit to show the correct number. The seven cathodes each illuminate a segment. They are arranged as in **Figure 8**, and are identified as (a), through (g). This figure shows how the number seven is displayed by selecting cathodes (a), (b), and (c). By activating the proper cathodes, all the characters between 0 and 9 can be displayed. Most displays also have an eighth cathode to

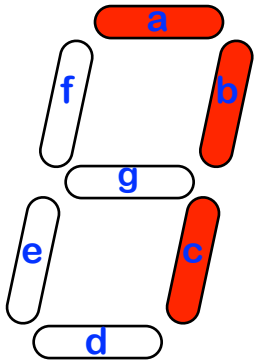


Figure 8: The seven-segments of the typical display, showing the digit 7 by illuminating segments (a), (b) and (c).

TEN DIGIT SEGMENT TABLE							
Digit	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**
1		X	X				
2	X	X		X	X		X
3	X	X	X	X			X
4		X	X			X	X
5	X		X	X		X	X
6	X		X	X	X	X	X
7	X	X	X				
8	X	X	X	X	X	X	X
9	X	X	X	X		X	X
0	X	X	X	X	X	X	

TABLE III

light a decimal, though it is not used in the clock. **Table III** shows which segments are lit for each of the digits one through zero. All six digits are displayed about every 8.5 millisecond, each being displayed for a bit over 1 mS; inter-digit blanking time is about 50 µS

The MK5017AA clock chip has eight control inputs. These also are multiplexed. There are two lines, KA and KB (pins 22 and 21 respectively) that are sensed each time digits 3, 4, 5, and 6 are enabled. Should the digit enable voltage be sensed on KA or KB, that signals an input is set. The eight inputs are shown in **Table IV**, and the schematic of the reset circuit is shown in **Figure 9.**

CAUTION: The early MK5017 data sheet contains an error. The KA and KB lines are shown reversed.

Diodes D201 through D205 isolate outputs. D204 is only installed if 50 Hz operation is needed. Diode D205 is hardwired to force 24 hour operation.

Ten-Minute Timer:

The 10-minute timer uses three 7490 TTL decade counters, and three DM8800 display drivers. The three display drivers convert the BCD output of the counters to control the seven segments of the three digit SP333 timer display. The display anodes are connected to the +230 volt supply through a voltage divider to reduce the intensity of the display, since it is not multiplexed. IC204 and IC202 count the full BCD range from 0 to 9 and back to 0. The 7490 counts on the high-to-low transition at its clock input. On the transition between 9 and zero the BCD-8 line, which is connected to the input of the next stage goes low causing the next stage to increment by one count. **Figure 10** is a partial schematic of the timer circuit, showing the counting and reset circuitry [7].

The MK-5017AA CLOCK INPUTS			
Data Sheet Name	**Heathkit Name**	**Data Line**	**Input Line ***
TS - Time Set	TIME HOLD	D6	KA
AS - Alarm Set	(not used)	D6	KB
SN - Snooze	(not used)	D5	KA
AE - Alarm Enable	(not used)	D5	KB
H**	HOURS SET	D4	KA
M**	MINUTES SET	D4	KB
24 - 24 Hour Time	none (hard wired)	D3	KA
50 - 50 Hz Line	50Hz (hard wired)	D3	KB
* SEE TEXT.	** USED TO SET HRS, 1 M, 10 M		

TABLE IV

The middle decade counter, IC203, counts the tens-of-minutes and only counts from zero to five and then resets to zero instead of incrementing to six. The 7490 resets to zero when the reset pins 2 and 3 both are high. These two reset inputs are connected to the BCD-2

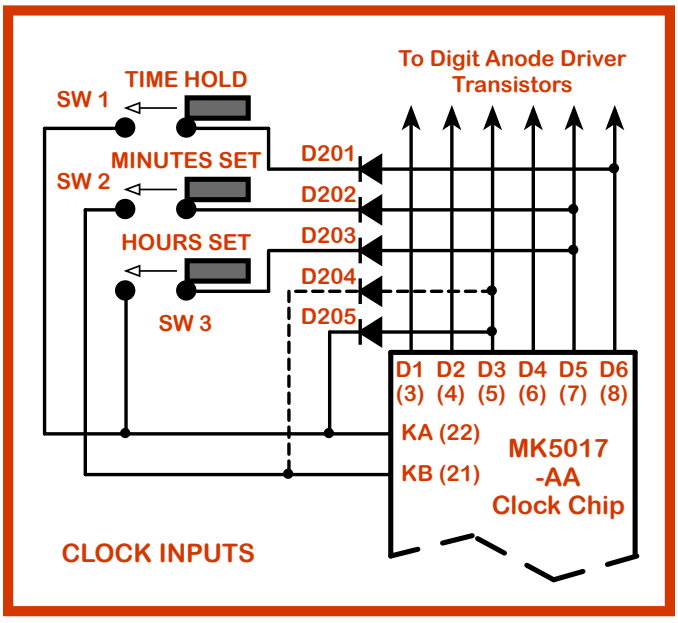
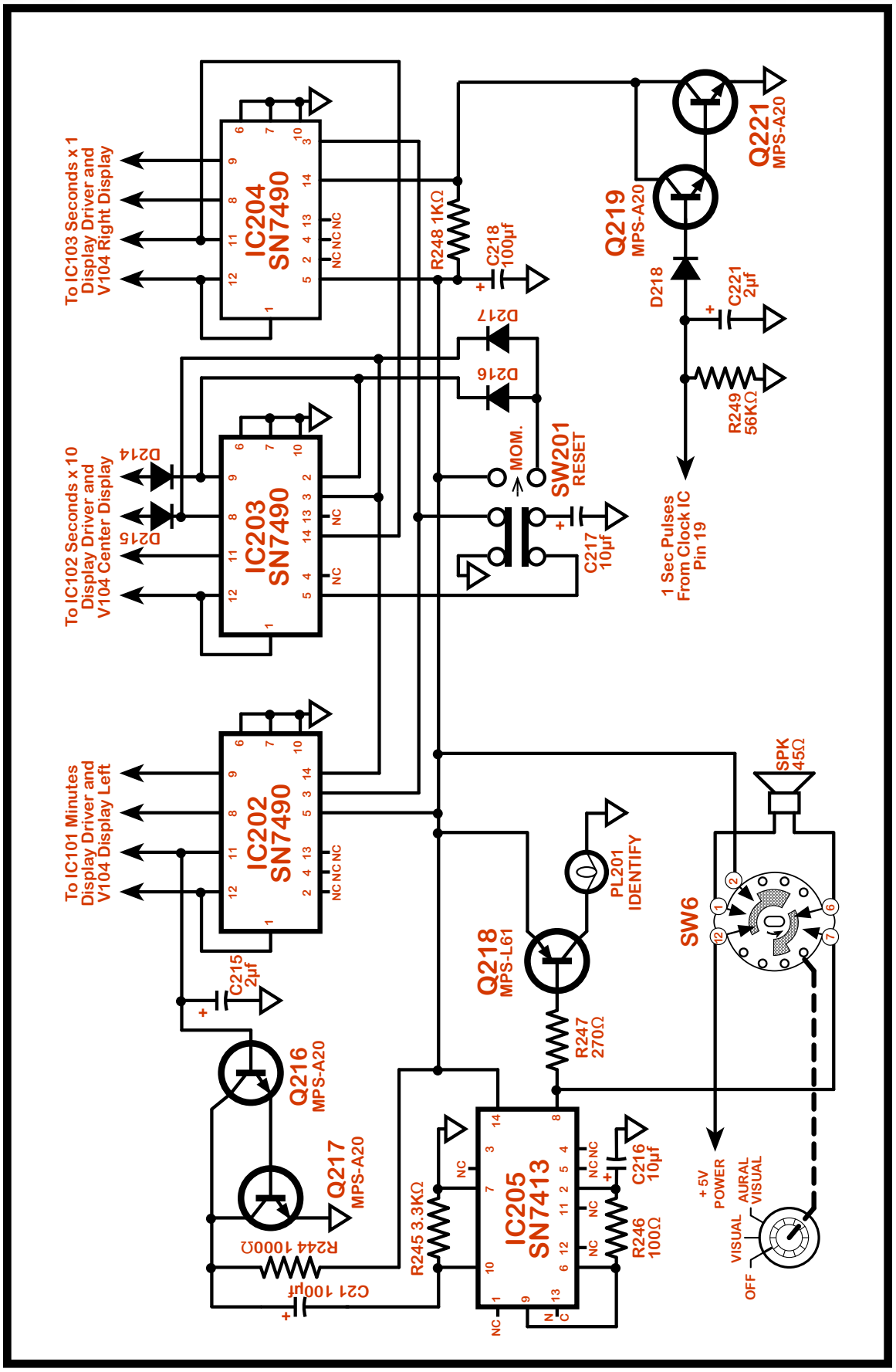


FIGURE 9: A Schematic of the five clock inputs of the MK5017AA that are used by the SB-634.


To IC103 Seconds x 1 Display Driver and V104 Right Display
IC204 SN7490
R248 1KΩ
C218 100µf
Q219 MPS-A20
Q221 MPS-A20
D218
C221 2µf
R249 56KΩ
1 Sec Pulses From Clock IC Pin 19
D217
D216
MOM.
SW201 RESET
C217 10µf
To IC102 Seconds x 10 Display Driver and V104 Center Display
IC203 SN7490
D214
D215
To IC101 Minutes Display Driver and V104 Display Left
IC202 SN7490
C215 2µf
Q216 MPS-A20
Q217 MPS-A20
R244 1000Ω
C21 100µf
R245 3.3KΩ
IC205 SN7413
C216 10µf
R246 100Ω
Q218 MPS-L61
PL201 IDENTIFY
R247 270Ω
SW6
SPK 45Ω
+ 5V POWER
AURAL
VISUAL
OFF

TIMER IC203 (Counts 0 to 5)				
COUNT	PIN 12 BCD 1	PIN 9, 2 BCD 2	PIN 8, 3 BCD 4	FORCE RESET
0	LOW	LOW	LOW	NO
1	HIGH	LOW	LOW	NO
2	LOW	HIGH	LOW	NO
3	HIGH	HIGH	LOW	NO
4	LOW	LOW	HIGH	NO
5	HIGH	LOW	HIGH	NO
6	LOW	HIGH	HIGH	YES

TABLE V

and BCD-4 lines The BCD-4 line (PIN 9) is also connected to the clock input of IC202, the minutes 7490 counter chip. When the count reaches four pin 9 goes high, setting one of the reset lines high and clock input of the minutes counter IC-202. Pin 9 remains high when the count is five. When the count changes from five to six the second reset line goes high forcing IC203 to reset which drives pin 9 low, causing the minutes counter to increment. This occurs so quickly that the six is not displayed.

Timer Reset:

While it is considered bad practice, TTL inputs that are left open act as if they are high. Pin 3 of IC202 and IC204 are open and thus in the high state. Pin 2 of these two ICs connect to the RESET switch and are normally grounded though its contacts. When the RESET button is pressed these pins connect to +5 volts causing the ICs to reset.

Resetting IC203 is a little more complicated. When the RESET switch is in the normal position C217 is across the 5V supply and ground and is fully charged. When RESET is pressed, the capacitor is connected to pins 2 and 3 of IC203 through isolation diodes forcing them high for a few milliseconds while the capacitor discharges. Another pair of isolation diodes prevent the capacitor discharge from reaching the display driver IC.

Timeout Alarm:

See Figure 11 for the following discussion. IC205 is a dual four-input NAND Schmitt trigger gate. Just one input is used on gate 'a' and two inputs are used on gate 'b'. Unused inputs are open and thus high. The output of these gates are normally high, going low only when all four inputs are high. When power is first applied the voltage across C216 is uncharged so pin 2 is low and the gate output, pin 6 is high. The output from pin 6 charges C216 through R246. When the voltage across C216 reaches the trigger level, the output, pin 6 goes low; discharging capacitor C216

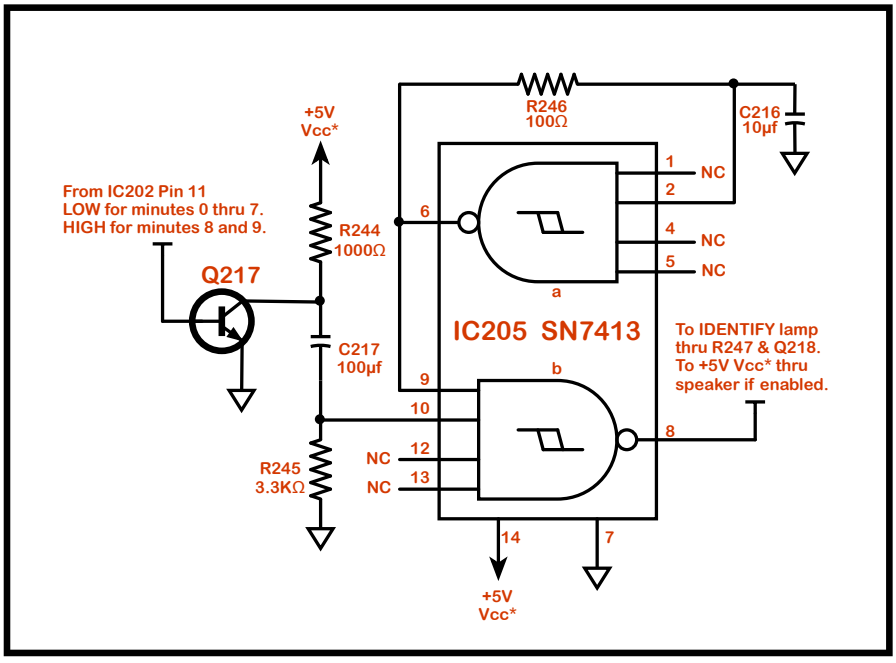


Figure 11: The 10 minute Timer Timeout Alarm from Figure 10. See text for discussion.

through R246. When the voltage drops below the Schmitt trigger level pin 6 goes high and the capacitor again starts charging. Thus there is a constant square-wave oscillation at an audio frequency occurring at pin 6 whenever the TIMER switch is not in the off position.

When the minutes counter (IC 202) is registering 0 through 7 minutes its pin 11 is low, and the Darlington pair composed of Q216 and Q217 is off, and C214 is being held charged by R244. Since C214 is charged, pin 10 of the 'b' gate is low and the gate output is high keeping Q218 off, (and if the TIMER switch is in the audible position, a high on both sides of the speaker.)

When the minute count reaches 8, IC202 pin 11 goes high turning on Q216 and Q217 which discharge C214. Pin 10 of IC205 remains low during the discharge. As long as Q217 is conducting, C214 remains discharged. IC202 pin 11 remains high during the ninth minute. At ten minutes the counter rolls over to 000 and IC202 pin 11 goes low. turning off Q216 and Q217. C214 immediately starts charging, making pin 10 of gate 'b' go high. The square wave on pin 9 now appears inverted on pin 8 where it turns on the IDENTIFY lamp and, if selected, causes the speaker to sound. The light and tone continue until C214 charges to the point the Schmitt trigger gate triggers; about one second.

The SB-634 in the Shack:

The SB-634 in the photos was purchased at one of the OCARC club auctions. One obvious problem was that the seconds display was not working. A second problem was that the rest of the display was intermittent, causing one segment in each digit of the clock not to display occasionally. The unit itself appeared well built and in good condition, other than a little dust. It cleaned up nicely except for the

Phone Phreaking

2,600 Hertz was an important tone in the worldwide telephone system in the sixties to the eighties. The tone was used by the phone system to signal that a long distance tandem was available. By calling a long distance toll-free number and, while the phone is ringing, sending the tone will cause the tandem to believe you hung up and stop the call, leaving you connected to the tandem (referred to as "seizing the tandem".) Using the proper tone codes you could then direct your call anywhere in the world, routing it from country to country or across the US and back. Numerous versions of the "Blue Box" were developed by the phreaks to create the twelve dual tones used by the phone company to send signals. Often the 2600 Hz was also built into the blue box.

One of the more famous phone phreaks used Cap'n Crunch as his alias. Ron Rosenbaum interviewed him (and others) in an October 1971 Esquire article.

Two famous "Phone Phreaks" were none other than Steve Wozniak and Steve Jobs, later to be the founders of Apple Computer. Wozniak designed a blue box that accurately produced the needed dual tones with some clever circuitry and, with Steve Jobs, produced and sold them. In one instance they ended up on the wrong end of a pistol when a buyer refused to pay. This incident is described in Steve Wozniak's autobiography "iWoz".

Continued

red transparent plexiglass filter over the displays. Evidently something had splattered on it and it was pitted. It was cleaned/polished as best possible but a trip to a plastics house is in the future.

The bad display was checked by swapping it with the minutes display, and confirming the problem was the display itself. Finding a replacement Sperry/Beckman SP352 required searching on the Internet. Surplus Sales of Nebraska has them for sale for about $50 ea.[8], but I was able to find a seller on eBay who was asking $25. His replacement display showed up in good working order.

While waiting for the display, the SWR/Power meter was checked and calibrated; its adjustment turned out to be pretty much right on. The intermittent display problem was tracked down to a damaged connection on a cable where it connected to the display board. Heathkit used small male bullet connectors (P# 432-121) that mount on the display board and mating female connectors (P# 432-120) that attach to a wire to make it easy to disconnect the wires and remove the display board as needed. Unfortunately one of the male bullet connectors had been damaged making it hard to reconnect the wire and evidently enough force had been used to break the solder connection between the connector and circuit board. This was the intermittent problem. After desoldering the connection, it was possible to MacGyver a temporary solution until a source for the bullet connector set can be found. The phone patch has yet to be checked, but should there be a problem, parts are available from an HD-15 parts unit. Besides, phone patching, once very common, has been rendered mostly obsolete by other communications techniques.

Phone Phreaking - continued

In an interview Jobs was quoted as saying:

> *"If it hadn't been for the Blue Boxes, there would have been no Apple. I'm 100% sure of that. Woz and I learned how to work together, and we gained the confidence that we could solve technical problems and actually put something into production."* – Steve Jobs

Here are a few references if you are interested in learning more about "Phone Phreaking". Note that most all control signaling for making phone connections today use "out-of-band" signaling and not in-band tones.

"Secrets of the Little Blue Box" by Ron Rosenbaum, *Esquire Magazine*, October 1971. Available online here: http://www.thestacksreader.com/secrets-of-the-blue-box-ron-rosenbaum-steve-jobs-influence/

"iWoz" by Steve Wozniak with Gina Smith (Chapters 6 and 7) ISBN 0-393-6143-4

"Basic Telephone Systems" [parts. I, II, III] by Spenser Whipple, "73 Magazine" April, May, & June 1975.

Clocks synced to the power line frequency no longer keep very accurate time, which makes this product a good candidate for the addition of either a much more accurate time base or for adding a WWVB or GPS controlled time base.

Heath of the Month:

Life has been a bit hectic lately, In the last few months, I've added new windows to the house as well as exterior paint. The ham shack is still half torn apart and too much

other stuff is taking up my time to get it back together. Meanwhile I picked up some interesting equipment that I'd like to get to. One is an early circa 1950 Heathkit SG-6 signal generator that looks in good shape. I have the capacitors to re-cap the unit and spent some time freeing up the 6:1 vernier tuning drive. Another item is a 1955 Allied Knight kit audio oscillator (Figure 10). It is an early Knight kit and doesn't even have a part number. Instead it uses the Allied catalog listing number which is "83 FX 137". This audio oscillator uses lots of electrolytic capacitors including two dual can types. Externally the kit looks pristine, but inside it is a bit sloppy. There is plenty of room inside to work so it might be a candidate for a full rebuild? I was able to find a paper manual for it in good condition. Also in the pile is a few Eico and Conar built kits that will likely be auctioned off at the October club auction.

73, from AF6C

Notes:

1. See HotM #107: Heathkit SB-630 Station Console. https://www.w6ze.org/Heathkit/Heathkit_107_SB630.pdf
2. See HotM #30: Heathkit SB-Line Overview: https://www.w6ze.org/Heathkit/Heathkit_030_SB_Line OV.pdf
3. Heathkit cleverly used a new design style that allowed the new style equipment to be close enough to be used with the older style and visa versa.
4. See HotM #54: Heathkit HM-102 RF Wattmeter. https://www.w6ze.org/Heathkit/Heathkit_054_HM102.pdf
5. https://www.w6ze.org/Heathkit/Heathkit_031_HD15.pdf
6. With the timer off, the clock alone draws a measured 4 volt-amperes.
7. The full Heathkit SB-634 schematic is available at: https://www.w6ze.org/Heathkit/Sch/SB634_Sch.pdf.
8. Surplus Sales of Nebraska: https://www.surplussales.com/ Look under Display Devices & Lamps.

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

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Thanks - AF6C

Figure 10: Allied 83 FX 137 Audio Generator ad from the 1955 Allied Radio catalog