Heathkit of the Month #116:
by Bob Eckweiler, AF6C

AMATEUR RADIO - SWL
Heathkit HD-1234
Antenna (Manual) Coax Switch.

Heathkit SA-1480
Antenna Remote Coax Switch.

Introduction:
In 1973 Heathkit came out with their first coax switch, the **HD-1234**. This switch was designed to be used in the shack and provides a way to switch one radio between four antennas, or one antenna between four radios, manually.

Six years later in the fall of 1979, with the HD-1234 still in production and selling well, Heathkit came out with the **SA-1480** Remote Coax Switch, see **Figure 1**. This switch could be located outside, in a convenient place and remotely switched from a small control unit in the ham shack. The operator could select any one of five antennas.

These switches were handy for those using multiple antennas. One position could be used to switch to a dummy load such as the Heathkit HN-31 "Cantenna". Both feature automatically grounding the unused antennas, and an additional position where all the antennas are grounded; helpful in areas with prevalent lightning activity.

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

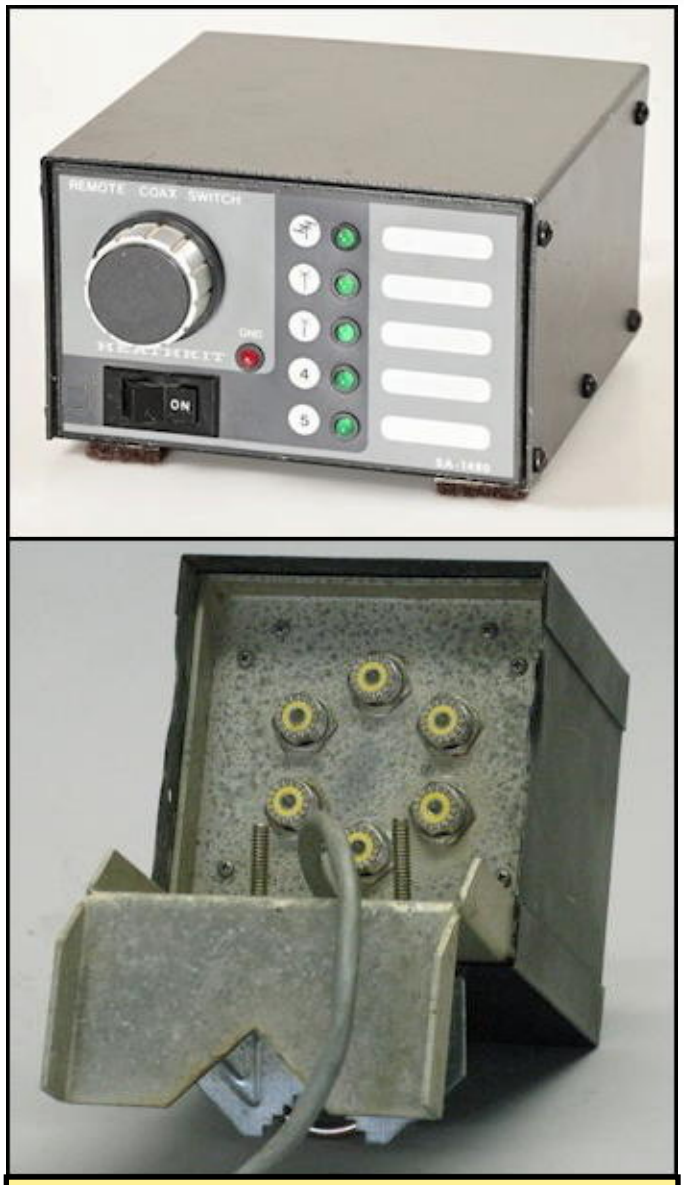


Figure 1: The two parts of the SA-1480 Switch
TOP - The SA-1480 Antenna Switch Controller
BOTTOM: The SA-1480 Remote Antenna Switch designed to be installed outdoors on a tower or other convenient location.

The HD-1234 Manual Antenna Switch:
First introduced in late 1973 for $11.95 the HD-1234 (**Figure 2**) remained in production into 1991; almost until the end of Heath Company as we knew it. By 1990 the HD-1234 was selling for $29.95, but in the Winter 1991 catalog it was on closeout sale for $24.95.

Figure 2: The HD-1234 Manual Antenna Switch with its five female UHF connectors and a ground post. Photo by Chuck Penson - WA7ZZE

The hexagonal shaped switch, similar to the B&W 550, has an SO-239 UHF connector on five of its six side surfaces; the sixth surface has a ground post consisting of a knurled nut on a 6-32 machine screw. The actual switch is a single ceramic wafer, indexed at 60°, having 6 positions for a full 360° rotation; there is no stop. The positions and associated connectors are marked: 1, 2, 3, 4, C, and G. Positions 1, 2, 3 and 4 connect the common (C) connector to antennas 1 through 4 respectively, and the three unselected antennas are connected to the ground post (G). In the C and G positions all four antennas are connected to the ground post (G) and the common connector (C) is open. Heath provided stickers depicting various antennas, dummy load and ground to apply over the numbers for personalization. Some of these are shown on the switch on **Figure 2**.

The HD-1234 schematic is shown in **Figure 3** (from the Heathkit Manual). The ceramic switch wafer has a front and rear switching section. The front section connects the common (C) connector to the selected antenna (positions 1 to 4); in the (C) and (G) positions it is open. The rear section connects the

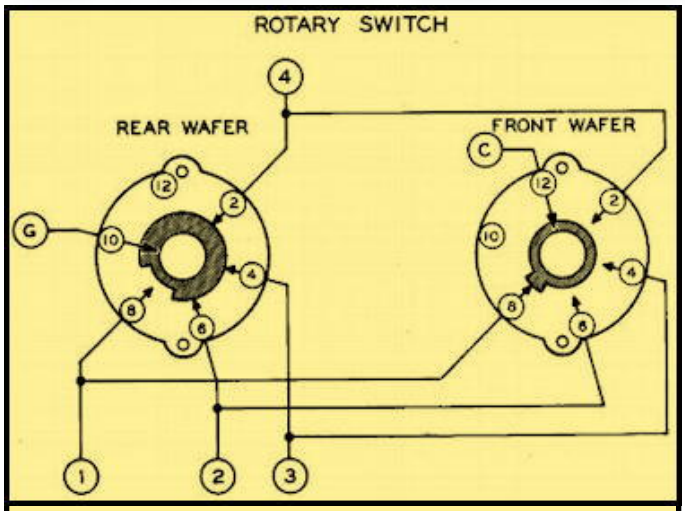


Figure 3: Simple schematic of the HD-1234. The switch is shown in the position to select antenna 1.

ground (G) post to all of the antenna connectors (positions 1 to 4) except for the selected connection. In the (C) or (G) position all four antenna connections are connected to the ground post. The hexagonal layout, along with the single two-sided wafer, provides very short leads. This keeps the SWR and losses low. (1.1:1 to 250 MHz) It can handle 1 KW or 2 KW PEP.

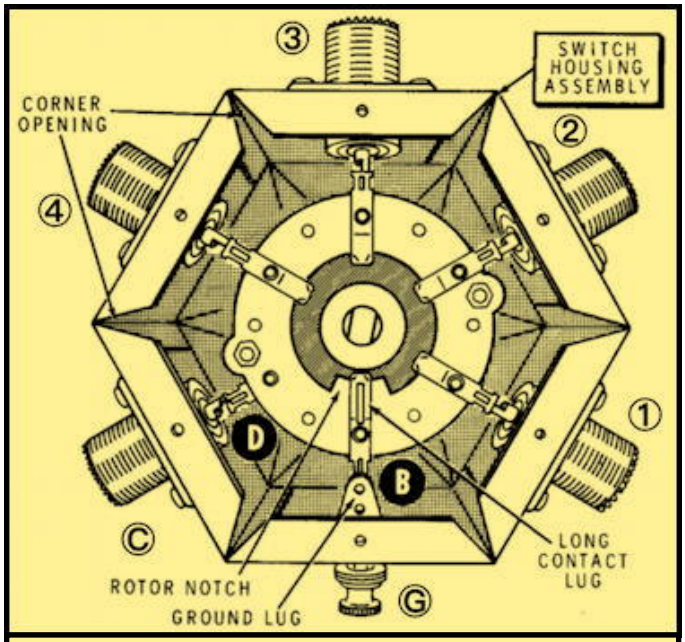


Figure 4: Rear inside drawing of the HD-1234. The switch is shown in the Ⓖround position.

The SA-1480 Remote Antenna Switch:

The SA-1480 (**Figure 1**) was first introduced in the Fall 1979 (#846) catalog. It was announced on the front cover along with two other kits (**Figure 5**). The initial ad in the catalog is shown in **Figure 6**. The introductory price was $84.95 from the factory and $89.95 at a Heathkit store.

The SA-1480 Remote Antenna Switch consists of two parts: the controller, which is located in the ham shack and the remote switch which could be located on a tower or other convenient place where it allows the shortest coax runs. The switch was designed to be located outdoors and is weather resistant. An eight conductor cable connects the switch to the controller. Heath sold the cable separately in three convenient lengths:

Part #	Length	Ship Wt.	Price *
IDA-1290-1	50 ft	2 lbs	$7.95
IDA-1290-2	100 ft	4 lbs	$13.95
IDA-1290-3	150 ft	6 lbs	$18.95

* 1973 Factory & Heathkit Store Prices.

The SA-1480 Specifications:

Specifications, taken from the manual, are shown in **Table I**. No line wattage or current was specified, but current draw is minimal when not switching.

The SA-1480 Controller Circuit:

The schematic for the SA-1480 controller is shown in **Figure 7**. The controller circuit is

Figure 5: SA-1480 Announcement on the front cover of the Fall 1979 Heathkit Catalog.

SA-1480 Specifications

Loss at 100 MHz:		< 0.2 db
VSWR:	< 3 0 MHz:	1.05 : 1
	< 150 MHz:	1.20 : 1
Impedance:		50 - 70Ω
Power Handling Capability:		2 KW PEP
Temperature range:		- 40° F to 177° F - 40° C to 80° C
Number of Ports:		5
Power Requirements:		120 / 240 VAC 50 / 60 Hz
Fuse	(wired for 120V):	3/16 A 250V S.B.
	(wired for 240V):	3/32 A 250V S.B.

Table I

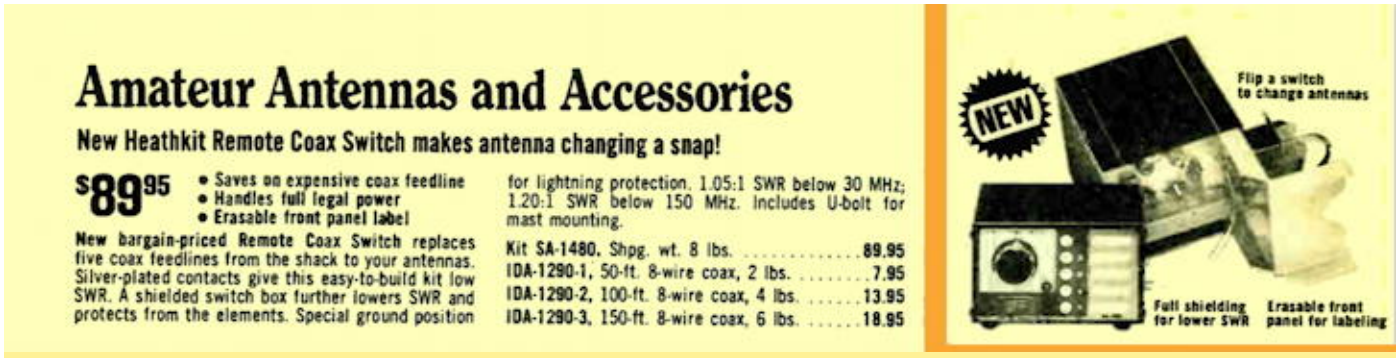


Figure 6: Ad on page 21 of the Fall 1979 Retail catalog (#846R) The factory introductory price was $84.95. If you purchased one from one of the Heathkit Retail stores, the price was $5 higher ($89.95).

very basic. Transformer T1 has a dual primary so it can be used with 120 or 240 volt power. The line cord has a polarized 2-prong plug. The hot side of the AC line has a fuse and power switch (SW1) in series before the transformer primary. The neutral side goes directly to the transformer primary. There is a 2.2 MΩ resistor (R1) between the neutral side and chassis ground. A guess is that it is there to bleed off any static charge accumulating from wind on the outdoor switch? Surprisingly there are no RF bypassing capacitors anywhere in either the controller or the switch itself.

The secondary of T1 is 20 VAC at ¾A. It is full-wave rectified by D1 – D4 and filtered by C1, producing about 30 VDC at low load. R2 acts as a bleeder and provides an 11 mA load. The voltage goes to a six-position rotary switch on the front of the controller (SW2). With the unit turned on, one of six LED lamps (D5 to D10) light depending on the position of the switch. Each LED has a 2.2 KΩ series resistor (R3 – R8) that limits the current through the LED to about 13 mA when powered. Five are green LEDs, and the one marked GND is red.

The eight-conductor cable (#22 AWG) connects to the controller via a six-position screw-type terminal strip on the rear of the cabinet. One of the mounting screws for the terminal strip has an extended bolt with an extra nut and washers to create a seventh terminal that is ground. When the controller power is on, +30 V appears on one of the six rear terminals, 1 through 6. Terminal 7 is the ground connection, and the black and white wires of the cable are paralleled to reduce any voltage drop. The other end of this cable connects to the remote switch. **Table II** shows the cable wiring.

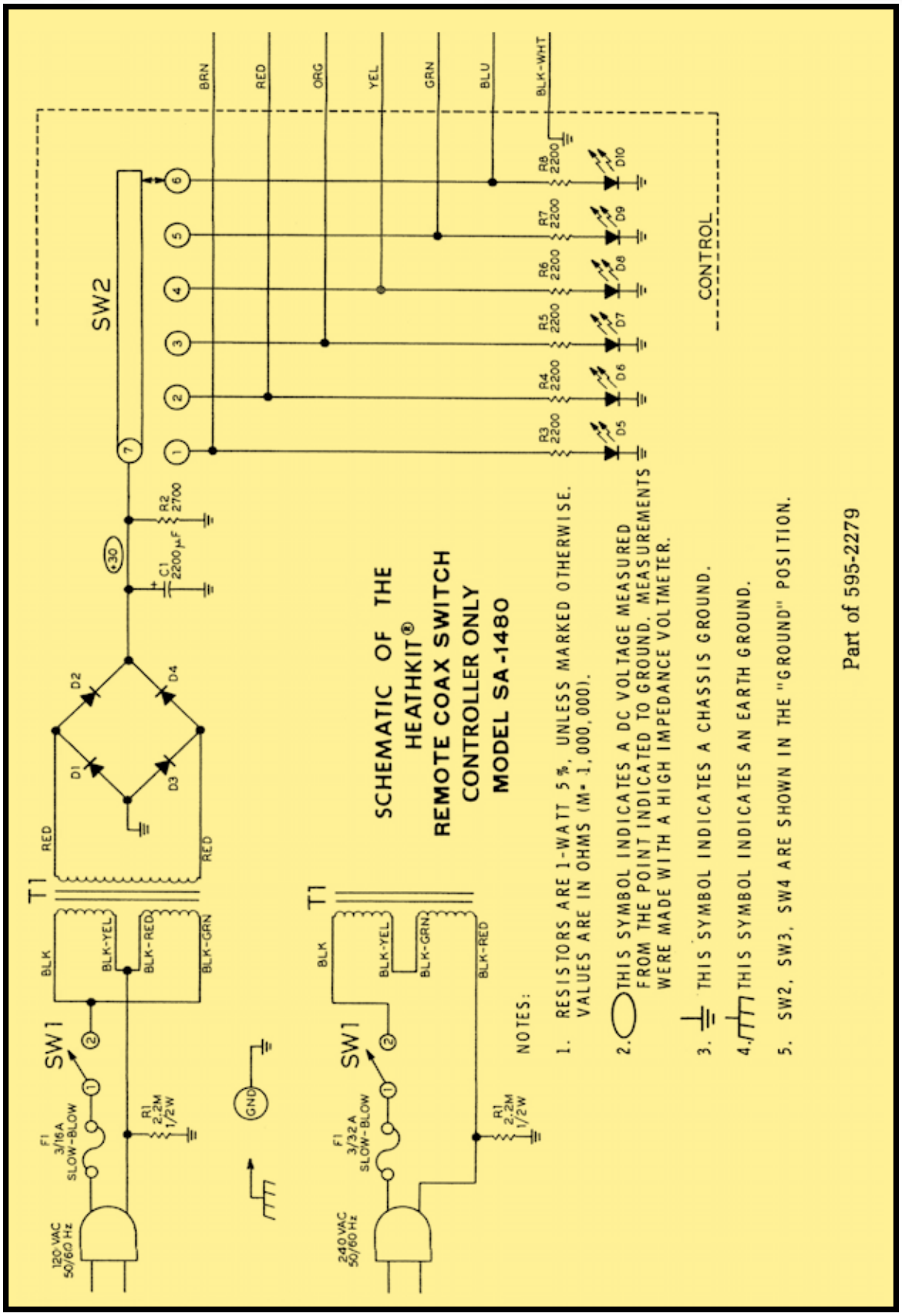
CNTLR TERM	LEAD FUNCTION	WIRE COLOR	SW. TERM
1	ANTENNA #1	BRN	1
2	ANTENNA #2	RED	2
3	ANTENNA #3	ORG	3
4	ANTENNA #4	YEL	4
5	ANTENNA #5	GRN	5
6	ALL ANTENNAS GROUNDED	BLU	6
7	COMMON LEADS BETWEEN CONTROLLER AND SWITCH (THE WIRES ARE PARALLELED)	BLK WHI	7

SA-1480 CABLE & TERMINAL TABLE

TABLE II

The SA-1480 Remote Switch Circuit:

A schematic of the remote switch circuit is shown in **Figure 8**. The heart of the remote switch is a Ledex solenoid driven switch. This switch has a built-in phenolic motor switch wafer (SW3 in Figure 8) and an extended shaft that rotates the antenna switch wafer (SW4). When power (nominally 28 VDC) is applied to the rotary solenoid it turns the shaft, through a pawl, rotating it 30º. When power is removed the solenoid returns to its resting position, but due to the action of the pawl, the shaft remains where it is. Thus each time power is applied, the switch turns an additional 30º. The switch only turns clockwise as viewed from the armature end. Built into the Ledex switch is a set of interrupter contacts, designated "pulse switch" on the Figure 8 schematic. These contacts can be wired to interrupt the current to the solenoid as it reaches the end of its travel. When in series with the solenoid coil this interrupter will cause the switch to rotate continually in 30º steps until power is removed elsewhere. The switch has no stops, so each twelve 30º-rotations turns the switch a


SCHEMATIC OF THE
HEATHKIT®
REMOTE COAX SWITCH
CONTROLLER ONLY
MODEL SA-1480
NOTES:
1. RESISTORS ARE 1-WATT 5%, UNLESS MARKED OTHERWISE. VALUES ARE IN OHMS (M=1,000,000).
2. THIS SYMBOL INDICATES A DC VOLTAGE MEASURED FROM THE POINT INDICATED TO GROUND. MEASUREMENTS WERE MADE WITH A HIGH IMPEDANCE VOLTMETER.
3. THIS SYMBOL INDICATES A CHASSIS GROUND.
4. THIS SYMBOL INDICATES AN EARTH GROUND.
5. SW2, SW3, SW4 ARE SHOWN IN THE "GROUND" POSITION.
Part of 595-2279
SW1
SW2
T1
F1 3/16A SLOW-BLOW
F1 3/32A SLOW-BLOW
120 VAC 50/60 Hz
240 VAC 50/60 Hz
R1 2.2M 1/2W
R2 2700
C1 2200 µF
+30
GND
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
R3 2200
R4 2200
R5 2200
R6 2200
R7 2200
R8 2200
BLK
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BLK-RED
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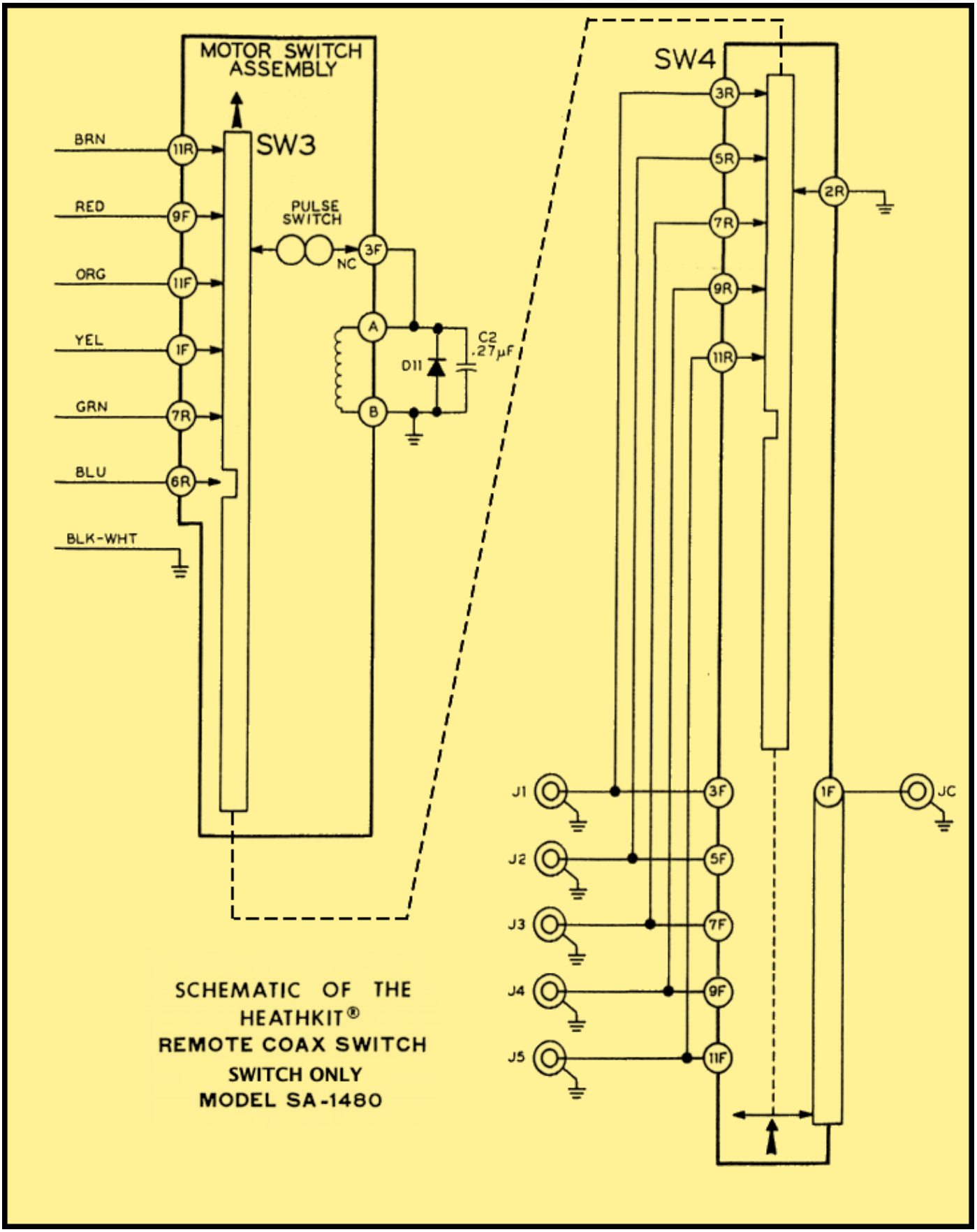
RED
BRN
ORG
YEL
GRN
BLU
BLK-WHT
CONTROL



SCHEMATIC OF THE HEATHKIT®
REMOTE COAX SWITCH
SWITCH ONLY
MODEL SA-1480

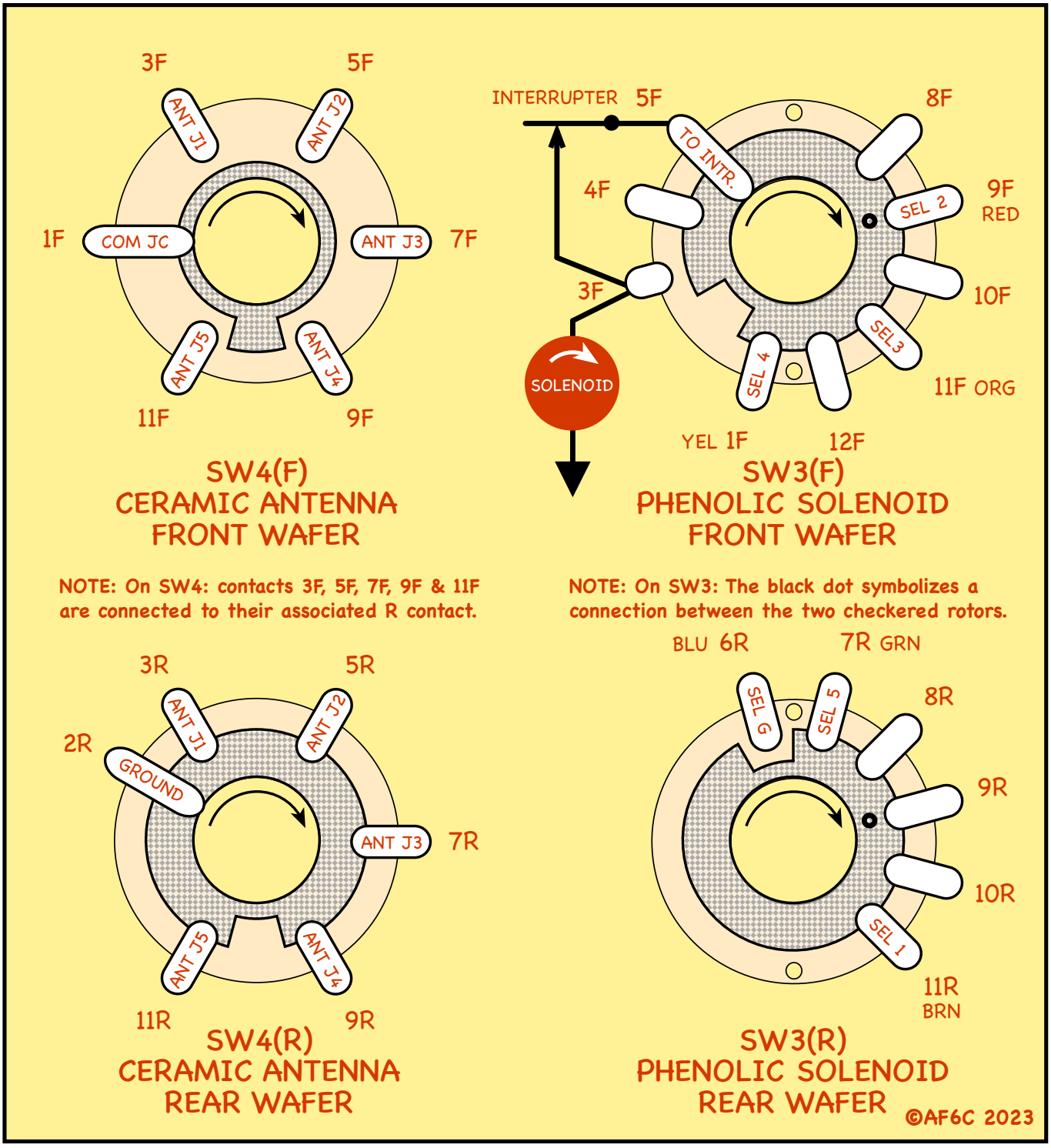


Figure 9: This drawing shows the two double-sided switch wafers driven by the rotary solenoid. On the left is the ceramic antenna switching wafer which connects the common connector JC to one of the five antenna connectors J1 - J5, and at the same time connects all the unused antennas to ground (SW4). On the right is the phenolic wafer that makes the solenoid keep stepping until the correct antenna is selected (SW5). A sixth signal from the controller selects “GND” which grounds all five antennas and disconnects the common input. The rear wafers appear as seen from the from side of the wafer.The black dot on the phenolic wafer indicates that the two rotors (checkered) are connected together. Switches are shown in the “GND” position.

full clockwise rotation, 360º.

When power is applied to one of the six control wires, the switch will turn clockwise until it reaches a point on the switch wafer that opens the circuit. Once there, the switch will remain in that position even if the controller is turned off. Each of the five antenna switch positions on the ceramic antenna switch are 60º apart. However when in the GND position, which grounds all the antennas and opens the common antenna connection, the ceramic antenna switch is at a 30º position between antenna 4 and 5 positions.

Figure 9 shows the layout of the two switch wafers SW3 and SW4. This drawing represents the most likely representation of the switch based on information that was able to be obtained without having the mechanism in-hand. In Figure 9 the switch wafers are shown in the GND position. Phenolic switch wafer SW3 is part of the Ledex drive. Since SW4 must be able to handle high power RF, it utilizes a ceramic wafer.

Both wafers have a front and rear switch section. The rear section is shown as if the viewer is looking through the front side of the switch, allowing the switch contacts to align front to back. The front side of the wafers is the side facing the solenoid.

With the controller turned on and its switch set so the red GND LED is lit, the controller is placing 30 VDC on the blue wire of the cable going to the remote unit. That wire connects to SW3 terminal 6R. Since the remote switch is already in the in the ground position there is no contact with terminal 6R and the switch remains where it is.

However when the controller switch is moved to, say, the antenna one position, the 30 VDC is no longer on the blue wire, but instead it is

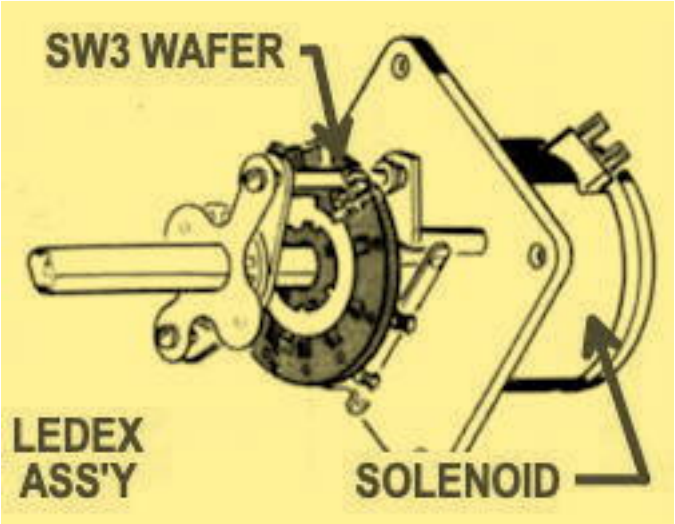


Figure 10:The Ledex solenoid drive as supplied by Heathkit. The long shaft engages the Ceramic antenna switch wafer SW4.

now on the brown wire which connects to SW3 terminal 11R. This places the voltage on the rear switch rotor. Since on SW3 the two rotors are connected together (as the black dot near the terminals 9F and 9R symbolize) the voltage also appears on the front rotor and terminal 5F. This voltage is connected through the normally closed contacts of the interrupter to the solenoid, causing the solenoid to activate and move the switch 30º clockwise. When the solenoid reaches the end of its travel the interrupter opens causing the solenoid to return to its resting position. However though the switch has moved 30º the connection between terminal 11R and the rotor remains and so the solenoid operates again, moving the switch another 30º. This happens a total of five times (150º total) until the notch in the rotor aligns with terminal 11R, removing the voltage from the rotor.

While the switch is stepping, all the LEDs on the controller light except for the position the switch is currently passing over.

Each time the interrupter opens the circuit a large counter EMF is created by the collapsing magnetic field of the solenoid coil. A

diode D11 is placed across the coil to shunt this spike. C2 is also across the coil to reduce RF noise as the motor steps.

The actual antenna switch wafer SW4 is also turned by the extended shaft of the solenoid. When in the ground position, as drawn in **Figure 9**, the common jack JC is open and all five antennas are grounded. However, after moving 150º as explained above, JC is connected to the J1 via SW4F while the ground is removed from J1 by SW4R, while the remaining 4 antennas are still connected to ground.

Accessing the other four antennas works similarly. Since the antenna switch is indexed by 60º the solenoid must operate twice to move to the next antenna position. However the ground position for the antennas is located at a 30º position half way between antenna 4 and 5.

While the controller supplies an unregulated 30 volts, the extra voltage drops a few volts due to the long feed cable and the heavy current draw of the solenoid.

An SA-1480 Weakness:

In Chuck Penson's book ***Heathkit - A Guide to the Amateur Radio Products*** **- Third Edition** he mentions the following warning in the section that discusses the SA-1480:

> **NOTE: Do not rotate the selector knob to a different antenna position without first placing the POWER switch to "ON". To do so may stall the switching motor.**

The note could not be found in the author's SA-1480 manual [595-2279-01] and it seemed that if you do have the switch set wrong, the motor wouldn't stall; the power supply would start putting out 30 volts and the motor would just step to the new position. Chuck and I swapped a few emails and he sent page (37) from the […-02] manual in which the note was added. The question then wa why? Of course! The power supply in the SA-1480 is marginal. When it's been on for a ½ second or even less the 2,200 µF filter capacitor has mostly charged up. When the solenoid is then operated the filter capacitor provides the needed extra current to step the solenoid.

However, if the selector knob has been moved to another position with the power off, the load of the solenoid is immediately impressed upon the starting up power supply. The coil resistance of the solenoid is low. Current flow is controlled more by inductance as the voltage builds up than by the DC resistance. The DC resistance only comes fully into play when the voltage reaches near maximum; and the current stops increasing. By that time the solenoid has rotated enough to open the interrupter. However, with the heavy load on at startup the voltage never rises to a high enough voltage to fully operate the solenoid, and the large filter capacitor will only charge up to a low voltage. Thus the solenoid stalls.

The HD-1481 Remote Antenna Switch:

In the fall 1984 Heathkit catalog #866 a new antenna switch was introduced, the HD-1481. Like the SA-1480, the new HD-1481 is comprised of an in-shack controller and a weather resistant remote switching unit. Instead of five antennas it is limited to four, and it does not ground the unselected antennas. What it does do is use the feed-line also as the control cable to select the desired antenna. Thus the long run of 8-conductor cable is not needed. The HD-1481 will be discussed in detail in an upcoming HotM article.

Heathkit Antenna Switches in 1984:

In the same catalog that introduces the HD-1481 all three antenna switches are shown on facing pages 36 and 37. At the time the HD-1234 was selling for $19.95, the

FIGURE 10: This partial photo is from the Fall 1984 Heathkit Catalog. It shows the control box for the new HD-1481 antenna switch (4), the soon to be discontinued SA-1480 control box with remote antenna switch (10) and the HD-1234 manual antenna switch (14). All three products were sold simultaneously for a few months in late 1984.

SA-1480 was selling for $99.95 (The IDA-1290-1, -2, -3 cables were selling for $9.95, $16.95 and $23.95 respectively) and the just introduced HD-1481 Remote Antenna Switch was introduced at $89.95. (See **Figure 10**) By. the time the Christmas 1984 catalog came out the same two pages had an almost identical layout as the previous catalog. However the SA-1480 was no longer listed. Added to the listing Heathkit introduced a new GRA-72 Long-wire SWL antenna for $9.95. The HD-1234 and HD-1481 were still shown, and the HD-1481 was still marked as "new". These two antenna switches lasted almost to when Heath closed its doors.

Comments:

I got interested in the SA-1480 when it was discussed on one of the Heathkit forums. In the sixties and seventies I worked with Scanivalves doing wind tunnel instrumentation. The common Scanivalves we used were driven by a Ledex rotary solenoid. It was basically a 6 pole 48 position pneumatic switch.

If anyone has access to the remote part of the SA-1480 and can confirm or correct my Figure 9 drawing of the SW3 wafer I'd appreciate it.

It's good to see the bands opening up with the current sunspot cycle. Time to dust off the old SB radios and give them some use.

73, from AF6C

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

Thanks - AF6C