

**Heathkit RS-1
Resistance Substitution Box**

Introduction:

Occasionally, when servicing a piece of electronic equipment you may find a resistor that has changed resistance or appears open. Sure, you can spend a lot of time replacing the component and see if that fixes the equipment. If it does you're in luck, but if it doesn't you've wasted time.

Resistance Substitution Box:

A Resistor Substitution Box is just a simple piece of test equipment with two terminals that allows the user to select one of numerous values of resistors. These resistors are usually 5% or 10% tolerance. Since resistors tend to in-



Figure 1: Heathkit RS-1 Resistance Substitution Box shown set for 470 ohms

crease in resistance as they age or get overheated, it is simple to clip the two leads from the box across the questionable resistor and slowly reduce the resistance of the box until the proper resistance is reached. If the device starts to work you know replacing the resistor will solve the problem. Of course, if the resistor is open just set the box to the needed resistor value. If you are designing a circuit, you can use this to choose the right resistor value for a bias circuit or see how intolerant your circuit is to resistance changes.

Resistance Substitution Boxes

<u>Model:</u>	<u>From:</u>	<u>To:</u>
RS-1	1952	1962
IN-12	1962	1967
EUW-28*	1964	1972
EU-28A*	1972	?
IN-37	1967	1978
IN-3137	1983	

Decade Resistance Boxes

<u>Model:</u>	<u>From:</u>	<u>To:</u>
RD-1	1949	1951
DR-1	1951	1961
IN-11	1961	1967
IN-17	1967	1978
EUW-30*	1964	1972
EU-30A*	1972	?
IN-3117	1978	END

* Part of the factory wired Malmstadt-Enke Instrumentation Lab by Heath.

Table 1: Heathkit Resistance Boxes & Approximate Production Years

Decade Resistance Box:

A Decade Resistance Box is a similar device but is for more precision work. It has five or six switches, one for each decade of resistance, so you can dial in any resistance (typically 1Ω to $99,999\Omega$ or $999,999\Omega$) in one ohm steps. These boxes are more for serious circuit development or laboratory work than troubleshooting.

Heathkit thought the Resistance Substitution Box and the Decade Resistance Box were viable pieces of test equipment. They sold five different models of the former and six of the latter over the years. Table 1 shows a best guess at the years these items were in production using available catalogs and information off the Internet.

Heathkit RS-1 Resistance Substitution Box:

The four resistance substitution box kits made by Heathkit (which excludes the EU series) were all electrically identical to the RS-1. The RS-1 contains thirty-six 1 watt 10% tolerance resistors, two 18-position rotary switches and a two-position slide switch. The slide switch selects which of the two rotary switches are in use. The lower rotary switch covers three decades of resistance from 15Ω to $10,000\Omega$. The upper rotary switch covers three decades of resistance from $15K\Omega$ to $10M\Omega$. Each decade has six values in a 15, 22, 33, 47, 68, 100 sequence. The selected resistance appears at a pair of binding posts. Since resistors are non-polarized, both binding posts are black in color.

The RS-1 mounts in a black bakelite box that measures 6" L x 3" W x 2" H. All the components mount on the aluminum face plate. Two paint schemes were used during the manufacture of the RS-1. The early model is finished in a light beige with red lettering, similar to other early Heathkit test equipment. The later model is shown in Figure 1; it is finished in dark grey with white lettering, similar to the style of the 60's line of test equipment.

The RS-1 Resistance Substitution Box sold for \$5.50 in 1956. This kit and its capacitor com-

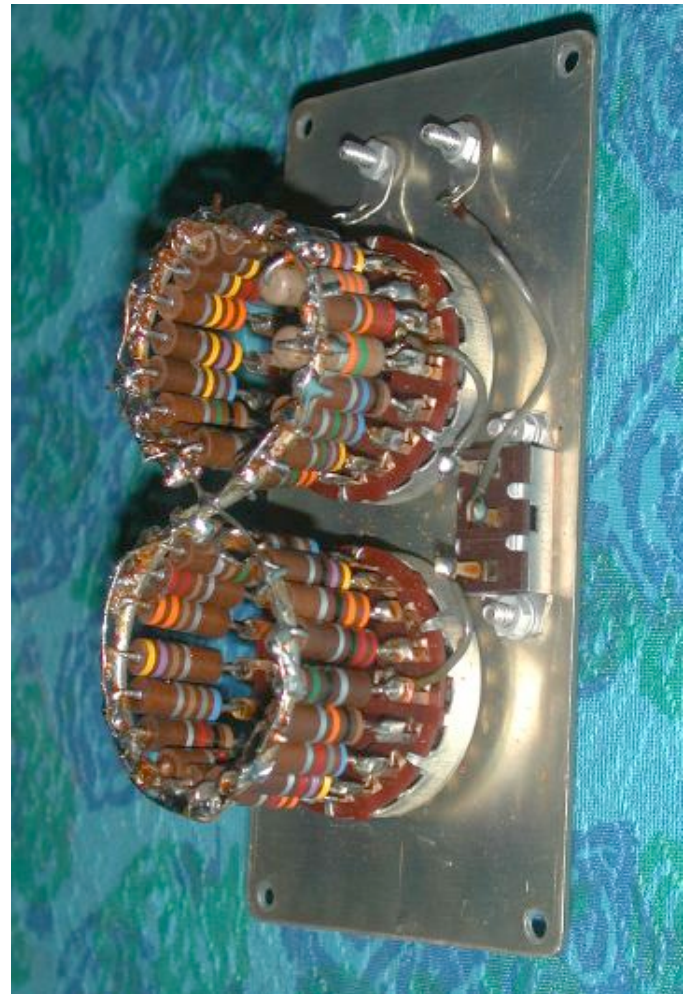


Figure 2: Heathkit RS-1 Resistance Substitution Box shown less case

panion, the CS-1 were basic kits and were usually only listed in the "Full" line Heathkit catalogs.

Later Heathkit Resistance Substitution Boxes:

Heathkit made four other resistance substitution boxes in kit form. They all appear to be identical in size and circuit, and they differ only in paint style, and plastic is more likely used instead of bakelite for the later boxes.

Two other resistance substitution boxes were sold factory wired as part of Heathkit's Malmstadt-Enke Instrumentation Lab, a series of test equipment for schools and science labs. These come in a sloping cabinet and have only one eighteen-position rotary switch, each posi-



Figure 3: Heathkit IN-3117 Resistance Decade Box

tion selects two values. A slide switch on the lower part of the panel determines which of the two values is used. I was not able to determine if the 36 values of resistance available in these boxes are the same as the RS-1? However, that is the likely case.

Heathkit Decade Resistance Boxes:

While the boxes discussed above are handy for troubleshooting, if you are doing something critical, like trying to balance a bridge circuit, you need finer control of the resistance. The Heathkit decade resistance boxes cover five or six decades of resistance starting at 1Ω and going to $99,999\Omega$ or $999,999\Omega$ depending on the the number of decades covered by the box. Heathkit's first two boxes, The RD-1 and later DR-1 both cover five decades. They come in a birch wood box with a metal plate mounting the five switches in a single row marked **UNITS, TENS, HUNDREDS, THOUSANDS** and **TEN THOUSANDS** as well as the two binding posts. In 1956 the DR-1 sold for \$16.50. These decade boxes contain 20 1% resistors, four for each decade in a 1, 2, 3, 6 arrangement with the proper resistors switched in series for the 1 to 9 value. Heathkit designed a special multi-deck switch for this purpose.

The later decade boxes cover six decades and have 9 equal resistors per decade. For instance the **X1** units decade has nine 1Ω resistors and the **X1K** thousands decade has nine $1,000\Omega$ resistors. The resistors for each decade are in series and the switch is a simple single-pole ten-position rotary switch that selects the correct number of resistors. The decades are all wired in series, and on later units they are marked: **X1, X10, X100, X1K, X10K, X100K**. The later units also feature 0.5% resistors for even higher accuracy.

In the 1991 catalog the last of the decade resistance boxes, the IN-3117, sold for \$99.95 (See Figure 3).

Summary:

The Heathkit RS-1 is a tool, and like most tools it will sit on the shelf until needed; then it can become very valuable in accomplishing the applicable task you have in mind for it.

The RS-1 featured in this article was given to me by Elmer Thomas - WA6PFA, who knew my interest in Heathkit. He included along with the RS-1 a CS-1 Capacitor Substitution Box; perhaps it will be the basis for a future article? Sadly Elmer recently became a silent key and will be missed.

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

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