

# HEATHKIT<sup>®</sup> MANUAL

**5 Megahertz  
Dual Trace  
Oscilloscope**  
Model IO-4205

595-2072



HEATH COMPANY • BENTON HARBOR, MICHIGAN

## HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information ..... (616) 982-3411  
Credit ..... (616) 982-3561  
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### *Technical Assistance Phone Numbers*

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## YOUR HEATHKIT 90 DAY LIMITED WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY  
BENTON HARBOR, MI. 49022

# Heathkit® Manual

for the

## 5 Megahertz Dual Trace Oscilloscope Model IO-4205

595-2072

series No. 03930

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# INTRODUCTION

The Heathkit Model IO-4205, 5 MHz, Dual-Trace Oscilloscope is a compact, versatile, easy-to-build, electronic instrument that you can use to study the waveforms in electronic circuits. You can also use it to measure frequency, and AC or DC voltages. The DC to 5 MHz bandwidth and the excellent input sensitivity of the vertical amplifiers allow you to use this Oscilloscope for nearly all types of waveform applications. The triggered horizontal sweep circuit and the many other outstanding features provide accuracy and capabilities that are usually found only in higher priced oscilloscopes.

Among the many other features this Oscilloscope offers are:

- A special TV position on the trigger selector. This allows low frequencies to pass while rejecting high frequencies, thus making it

easier to trigger on the vertical frequency of a TV set.

- A 10 to 1 attenuation circuit that can be used for signals applied to the external, horizontal input jack.
- Accurately calibrated vertical attenuators with variable controls.
- A calibrated time base (seven time base selections, variable within each selection).

These features, along with the attractive styling, will make this Oscilloscope a welcome asset to the laboratory, service shop, or the ham shack.

# UNPACKING

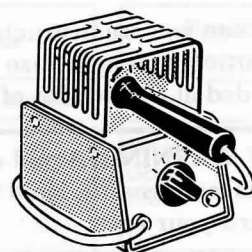
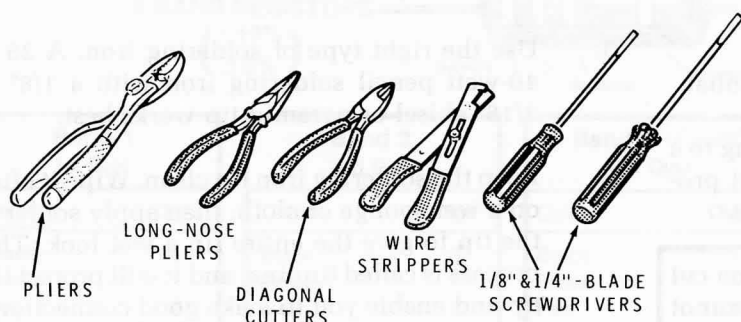
Inside the shipping carton was the box stamped PK1 which contained this Assembly Manual. With this box removed from the shipping carton, you will find bags stamped PACK 2 through PACK 4. The Manual will refer to these areas as “packs.” You will be directed to open each of these “packs” as it is needed. All other parts in the shipping carton will be considered the “final pack.” Caution: Do not remove any parts from their bags or the “final pack” until they are specifically called for in a Parts List in the Manual.

Each assembly section of the Manual contains its own “Parts List” and “Step-by-Step Assembly” instructions. At the beginning of each “Parts List,” you will be instructed to open one of the packs. You will also be directed, in some Parts Lists, to remove certain parts from the final pack.

# ASSEMBLY NOTES

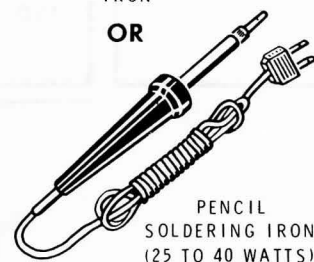
## TOOLS

You will need these tools to assemble your kit.



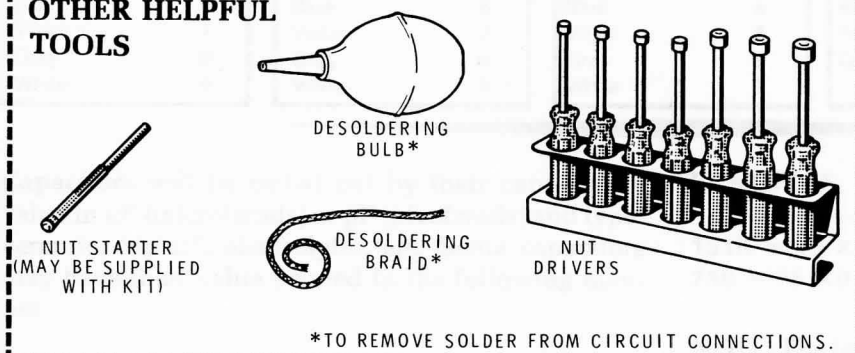
HEATHKIT  
SOLDERING  
IRON

OR



PENCIL  
SOLDERING IRON  
(25 TO 40 WATTS)

## OTHER HELPFUL TOOLS



\*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

## ASSEMBLY

- Follow the instructions carefully. Read the entire step before you perform each operation.
- The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
- Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Position all parts as shown in the Pictorials.
- Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:
- In the Parts List,
  - At the beginning of each step where a component is installed,
  - In some illustrations,
  - In the Schematic,
  - In the section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

**SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.**

## SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

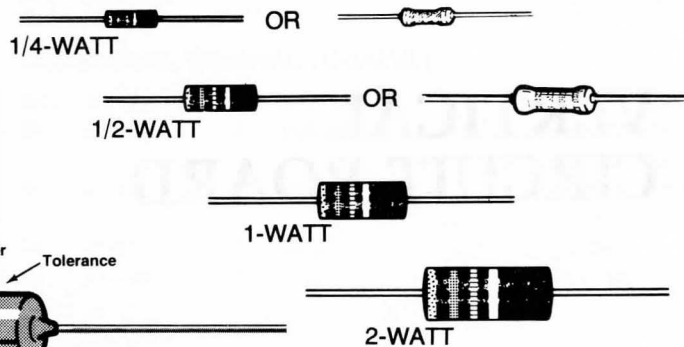
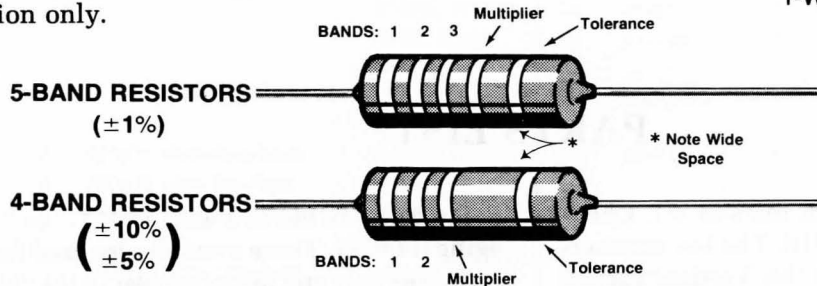
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.



## PARTS

**Resistors** will be called out by their resistance value in  $\Omega$  (ohms), k $\Omega$  (kilohms), or M $\Omega$  (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.



| Band 1<br>1st Digit |       | Band 2<br>2nd Digit |       | Band 3 (if used)<br>3rd Digit |       | Multiplier |            | Resistance<br>Tolerance |            |
|---------------------|-------|---------------------|-------|-------------------------------|-------|------------|------------|-------------------------|------------|
| Color               | Digit | Color               | Digit | Color                         | Digit | Color      | Multiplier | Color                   | Tolerance  |
| Black               | 0     | Black               | 0     | Black                         | 0     | Black      | 1          | Silver                  | $\pm 10\%$ |
| Brown               | 1     | Brown               | 1     | Brown                         | 1     | Brown      | 10         | Gold                    | $\pm 5\%$  |
| Red                 | 2     | Red                 | 2     | Red                           | 2     | Red        | 100        | Brown                   | $\pm 1\%$  |
| Orange              | 3     | Orange              | 3     | Orange                        | 3     | Orange     | 1,000      |                         |            |
| Yellow              | 4     | Yellow              | 4     | Yellow                        | 4     | Yellow     | 10,000     |                         |            |
| Green               | 5     | Green               | 5     | Green                         | 5     | Green      | 100,000    |                         |            |
| Blue                | 6     | Blue                | 6     | Blue                          | 6     | Blue       | 1,000,000  |                         |            |
| Violet              | 7     | Violet              | 7     | Violet                        | 7     | Silver     | 0.01       |                         |            |
| Gray                | 8     | Gray                | 8     | Gray                          | 8     | Gold       | 0.1        |                         |            |
| White               | 9     | White               | 9     | White                         | 9     |            |            |                         |            |

**Capacitors** will be called out by their capacitance value in  $\mu\text{F}$  (microfarads) or pF (picofarads) and type: ceramic, Mylar\*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

First digit of capacitor's value: 1

Second digit of capacitor's value: 5

Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.

To find the tolerance of the capacitor, look up this letter in the Tolerance columns.



### EXAMPLES:

$$151K = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or  $\mu\text{F}$ ).

| MULTIPLIER      |              | TOLERANCE OF CAPACITOR |        |            |
|-----------------|--------------|------------------------|--------|------------|
| FOR THE NUMBER: | MULTIPLY BY: | 10 pF OR LESS          | LETTER | OVER 10 pF |
| 0               | 1            | $\pm 0.1 \text{ pF}$   | B      |            |
| 1               | 10           | $\pm 0.25 \text{ pF}$  | C      |            |
| 2               | 100          | $\pm 0.5 \text{ pF}$   | D      |            |
| 3               | 1000         | $\pm 1.0 \text{ pF}$   | F      | $\pm 1\%$  |
| 4               | 10,000       | $\pm 2.0 \text{ pF}$   | G      | $\pm 2\%$  |
| 5               | 100,000      |                        | H      | $\pm 3\%$  |
|                 |              |                        | J      | $\pm 5\%$  |
| 8               | 0.01         |                        | K      | $\pm 10\%$ |
| 9               | 0.1          |                        | M      | $\pm 20\%$ |