# INTRODUCTION

The Heathkit Model HD-16 Code Oscillator provides you with a simple, inexpensive means of learning the telegraphic code. The telegraph key that is furnished with the Kit is the only external equipment required for forming either audible or visual code characters.

A front panel switch permits you to select either audible or visual code signals. The audible signal is provided by a relaxation oscillator with adjustable tone and volume. A phone jack is provided so that headphones may be used if there are distracting noises within the room. The visual signal is produced by a lamp at the top of the cabinet.

This Code Oscillator provides you with the means to develop code receiving and transmitting ability. Both of these abilities are required to obtain an amateur radio license from the Federal Communications Commission. It is recommended that two persons learn the code together by sending to each other, whenever possible. Additional comments on this subject are contained in the Learning The Code section of this Manual.

The styling of the Code Oscillator is compatible with the SB series of Heath amateur radio equipment. This versatile, portable, and reliable Code Oscillator will have a strong appeal to those individuals or groups who have a sincere desire to learn the telegraphic code.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, tools, wiring, soldering, and step-by-step assembly procedures.

# OPERATION

Refer to Figure 1 for the following instructions.

1. Position the LIGHT switch at OFF.

2. Insert the plug from the key into the KEY jack as far as possible.

3. Depress (close) the key with one hand. Use the other hand to adjust the TONE and VOLUME. The highest-pitched tone will be heard with the TONE knob at full counterclockwise rotation. The loudness will increase as the VOLUME control is rotated in a clockwise direction. NOTE: It is not unusual for the TONE and VOLUME adjustments to interact.

4. Position the LIGHT switch at ON if you wish to eliminate the tone. This will turn off the sound and cause the lamp to light when the key is closed.

NOTE: A pair of headphones may be plugged into the PHONES jack to provide personal listening and silence the speaker.

Figure 2 shows the suggested position for the hand on the key knob. Work the key with simultaneous hand and wrist movements. The use of hand movements alone tends to create muscle tension and will soon become tiring. Try to keep your hand and arm muscles as relaxed as possible.
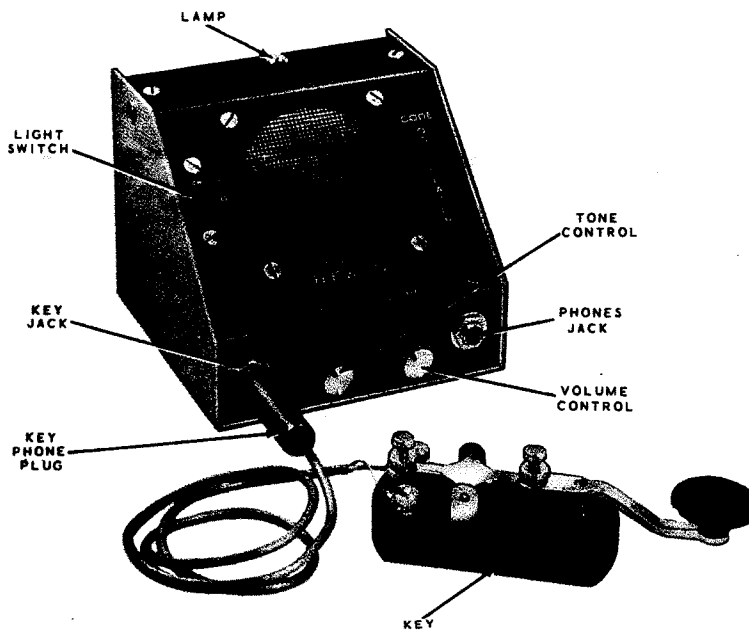


LAMP

LIGHT SWITCH

TONE CONTROL

KEY JACK

PHONES JACK

VOLUME CONTROL

KEY PHONE PLUG

KEY

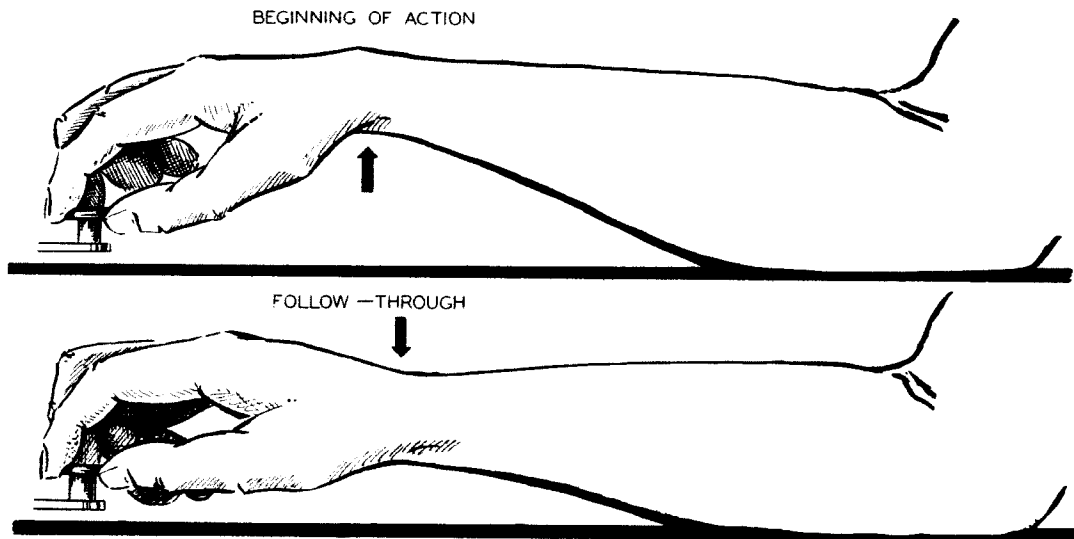Figure 1

BEGINNING OF ACTION

FOLLOW —THROUGH

**Figure 2**

# LEARNING THE CODE

The Continental (International) Morse code is a language of sound. Although it can be recorded on paper, it is most often sent and received as sound. Thus if at all possible the code should be learned as sound. The "sound" of the letter "A" in code, for example, should implant the letter "A" directly into the mind of the receiving operator. If the code were learned from a printed page, the operator would first have to convert the sound of "A" in code to a "dot-dash" symbol, as shown on a printed page; and then he would have to convert the symbol into the letter "A" in his mind. This would consume more time and make it much more difficult to acquire code speed.

The code can best be learned by having some member of your family, or a friend, send a few letters at a time to you with the Code Oscillator. A letter should be called out (pronounced) and then keyed. These small groups of letters can be sent, with pauses after each letter, until you learn them. In similar fashion, additional small groups of letters can then be learned. During this learning process, the selection of the letters for these first groups should be such that simple words can be formed. This will tend to speed up learning.

The person sending the code should use the Code Chart, Figure 3 as his text. First, the sender should concentrate on proper formation of the characters and smoothness of keying. Speed in sending will come later when the characters become more familiar.

The code symbols are designated in speech by operators as "dit" and "dah" instead of "dot" and "dash". Thus, the letter A (. -) is "didah"; the "t" being dropped in such combinations. The "di" sound should be staccato. The number "5" (. . . . .) in spoken code language should sound like a machine-gun burst: "dididididit." Each "dah" should be stressed equally, with one being no shorter or longer than another.

## INTERNATIONAL MORSE CODE

| | | | | | |
|---|---|---|---|---|---|
| A | ●— | didah | N | —● | dahdit |
| B | —●●● | dahdididit | O | ——— | dahdahdah |
| C | —●—● | dahdidahdit | P | ●——● | didahdahdit |
| D | —●● | dahdidit | Q | ——●— | dahdahdidah |
| E | ● | dit | R | ●—● | didahdit |
| F | ●●—● | dididahdit | S | ●●● | dididit |
| G | ——● | dahdahdit | T | — | dah |
| H | ●●●● | didididit | U | ●●— | dididah |
| I | ●● | didit | V | ●●●— | didididah |
| J | ●——— | didahdahdah | W | ●—— | didahdah |
| K | —●— | dahdidah | X | —●●— | dahdididah |
| L | ●—●● | didahdidit | Y | —●—— | dahdidahdah |
| M | —— | dahdah | Z | ——●● | dahdahdidit |

| | | | | | |
|---|---|---|---|---|---|
| 1 | ●———— | didahdahdahdah | 6 | —●●●● | dahdidididit |
| 2 | ●●——— | dididahdahdah | 7 | ——●●● | dahdahdididit |
| 3 | ●●●—— | didididahdah | 8 | ———●● | dahdahdahdidit |
| 4 | ●●●●— | dididididah | 9 | ————● | dahdahdahdahdit |
| 5 | ●●●●● | dididididit | 0 | ————— | dahdahdahdahdah |

| | | |
|---|---|---|
| Period | ●—●—●— | didahdidahdidah |
| Comma | ——●●—— | dahdahdididahdah |
| Question Mark | ●●——●● | dididahdahdidit |
| Error | ●●●●●●●● | dididididididit |
| Double Dash | —●●●— | dahdidididah |
| Wait | ●—●●● | didahdididit |
| End of Message | ●—●—● | didahdidahdit |
| Invitation to Transmit | —●— | dahdidah |
| End of Work | ●●●—●— | dididdahdidah |
| Fraction Bar | —●●—● | dahdididahdit |

## FIGURE 3
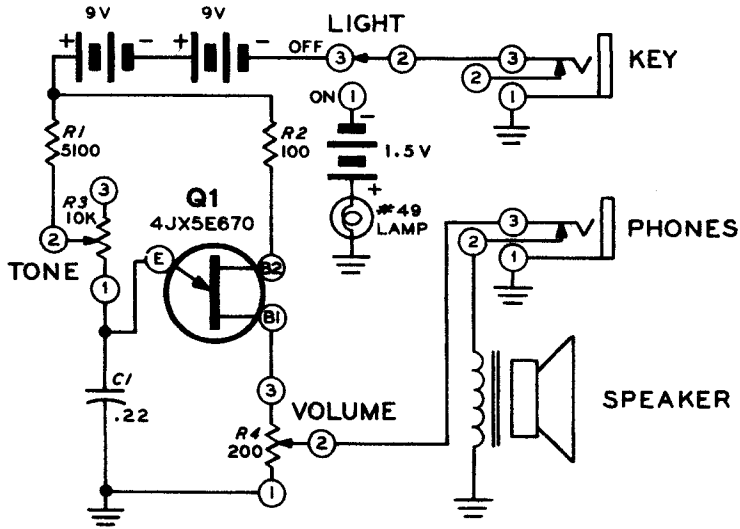
**SCHEMATIC OF THE**
**HEATHKIT®**
**CODE OSCILLATOR**
**MODEL HD-16**

NOTES:
1. ALL RESISTORS ARE 1/2 WATT.
2. ALL RESISTOR VALUES ARE IN OHMS (K=1000).
3. ALL CAPACITOR VALUES ARE IN $\mu$fd.
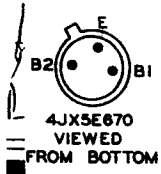
Many operators recommend that as you go about your daily work, or as the opportunity presents itself, you spell out the names of common objects around you in "didah" language, either silently to yourself or aloud. Any characters that seem to be especially difficult should be given special attention and repetition until they no longer remain a problem.

If you have a radio receiver capable of receiving amateur radio station W1AW (the headquarters station of the American Radio Relay League, 225 Main Street, Newington, Connecticut, 06111) you will find that it transmits code practice twice nightly. The station's schedule as to time and frequencies can be secured from the American Radio Relay League magazine "QST", from a local ham, or by sending a postcard of inquiry direct to the address given above. You might also wish to inquire about the League publication "Learning the Radio Telegraph Code," which contains practice material for both home study and classroom use.

Determination is required to learn the code, just as in learning to type by touch. Only practice and more practice will produce results. Your immediate objective may well be an amateur radio license. For this, the Federal Communications Commission requires that you demonstrate your ability to both send and receive code in an acceptable manner at prescribed speeds. You will find this Code Oscillator an invaluable aid.

# IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead and wire in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair are defective due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as illustrated in the Soldering section of the Kit Builders Guide.

3. Check the values of the component parts. Be sure that the proper parts have been wired into each circuit, as shown in the Pictorials and as called out in the wiring instructions.

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring or components, causing a short circuit.

5. Tone variation, or a warbling note during keying, is usually caused by poor contact in the keying circuit or at the key contacts themselves. The key contacts may be cleaned by drawing a strip of emery paper between the contacts with very slight pressure on the key knob. Turn the strip of emery paper over and draw it through a second time to clean the other key contact.

6. A definite dimming of the light indicates a weak C cell battery; little or no tone output indicates that the 9-volt batteries may be weak.

7. The complete absence of tone or light indicates that the key contacts are dirty or not closing, or that the Plug is in the wrong jack.

8. A continuous tone or light may indicate closed KEY contacts or a short circuit in the key cable or other parts of the keying circuit.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty sections of the "Kit Builders Guide", and to the "Factory Repair Service" information on the fold-out from Page 15 of this Manual.

# SPECIFICATIONS

| | |
|---|---|
| Modes Of Operation. . . . . . . . . . . . . . . . . . . . | Audible tone from speaker or headphones. Visual indication from lamp. |
| Tone Frequency. . . . . . . . . . . . . . . . . . . . . | 500 Hz nominal center frequency (adjustable). |
| Controls. . . . . . . . . . . . . . . . . . . . . . . . . . . | Volume control. Tone control. Light switch (Off-On). |
| Front Panel Connections. . . . . . . . . . . . . . . | Key jack (key furnished). Phones jack. |
| Speaker. . . . . . . . . . . . . . . . . . . . . . . . . . | 130 ohms, permanent magnet type. |
| Transistor. . . . . . . . . . . . . . . . . . . . . . . . | 4JX5E670, GE unijunction. |
| Batteries Required (not supplied). . . . . . . . . . | 1 - C cell (1.5 volt). 2 - #9-volt transistor batteries (NEDA #1604. See the note at the bottom of Page 3). |
| Color. . . . . . . . . . . . . . . . . . . . . . . . . . . . | Dark green and pale gray. Wrinkle enamel finish. |
| Dimensions. . . . . . . . . . . . . . . . . . . . . . . . | 4-5/8" wide x 4-1/4" high x 4-3/4" deep (phone plug not inserted). |
| Net weight. . . . . . . . . . . . . . . . . . . . . . . . | 1-1/3 lbs. |

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

# CIRCUIT DESCRIPTION

Refer to the Schematic while reading the following description.

The unijunction transistor, Q1, is a special type of semi-conductor device, with two bases and one emitter, which acts as a relaxation oscillator in the following manner: When the key is closed, capacitor C1 is charged by the battery voltage through resistor R1 and the Tone control until the Emitter (E) voltage reaches the point at which the emitter is forward biased with respect to B2. Emitter current then flows because the dynamic resistance between the emitter and base one (B1) then drops to a low value. R2 drops the battery voltage to a low level, permitting C1 to charge to a higher voltage than B2.

Capacitor C1 discharges through the Emitter and Volume control until the voltage at the Emitter drops to the point where the Emitter is no longer forward biased. The cycle then repeats itself at a rate governed by the setting of the Tone control.

The pulsating base current, or oscillator signal, is developed across the Volume control. From the arm of the Volume control, the signal is coupled through the normally closed contacts of the phones jack to the speaker.

The lamp circuit uses the key as a switch that makes and breaks the C cell battery voltage to the lamp.