# A Low-Cost Dot-Memory Keyer

Ready to move up to an electronic keyer? Here's a weekend project that won't bankrupt you.

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Electronic keyers are popular home projects because they provide amateurs with a quality instrument with which to send perfect cw. The cw operator will appreciate the ease of building this keyer and take pride in designing his own enclosure and power supply. There is room for a personal touch to this project. All components for the keyer are readily available from mail-order suppliers and local electronic parts houses.

### Operational Characteristics

The heart of the keyer is the 555 IC timer, thanks to its ability to operate over several decades of speed range without modification or component changes. Other clocks built from one-shot ICs or discrete components will usually only operate over a 6 to 10:1 speed range before components or timing capacitors require changing or operation fails completely. The timer in this circuit is wired in a nonstandard, inverted-output mode so that keying will be smooth and uniform, even on the first dot, with uniform spacing between characters.

The keyer has dot memory, which is particularly useful when using a single-lever paddle. The memory allows loading a dot while a dash is still being sent. Then after a space the dot will be sent perfectly. This eliminates the choppiness found in operating many nondot-memory keyers.

Dot insertion is available when using a "squeeze" paddle with the dot-memory keyer. The dot paddle will insert dots between or after dashes, even though the dash paddle is not released. Dot memory is convenient when forming characters like K, X or $\overline{BT}$. The dot is sent first when both paddles are squeezed.

The KEY-TUNE input is particularly useful, not only for tuning the rig but also for playing messages that are stored in some form of digital memory for contests or code practice. The input may also be used with a straight key or in conjunction with the dot input to simulate a mechanical "bug" key.

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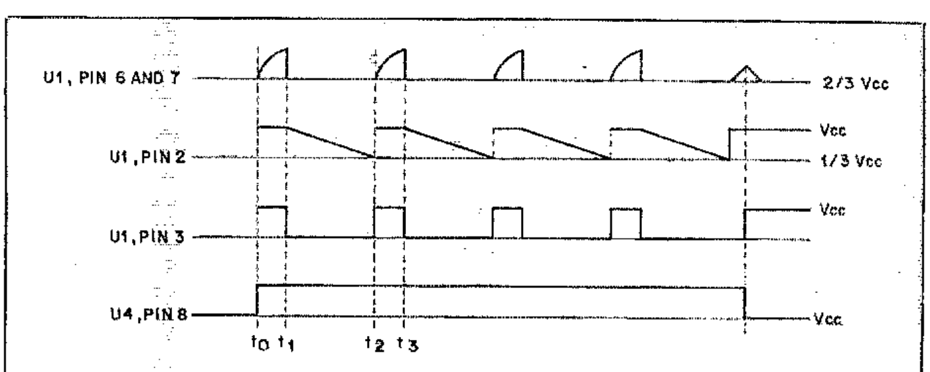
### The Heart of the Keyer: The Clock

The clock is made up of the 555 timer IC and associated components. Operation of the clock can best be described by the timing diagram, Fig. 1. The actual circuit is shown in Fig. 2.

In the unkeyed state, pin 8 of U4A is in the low state. When keyed, $t = t_0$, and pin 8 goes high, quickly charging capacitor C10 through R3 until time $t_1$. Time $t_1$ occurs when the threshold, pin 6, reaches two-thirds Vcc and causes pins 3 and 7 to be pulled low and initiate two control events. First, pin 3 toggles the keyer and enables the variable time-out period $(t_2 - t_1)$, determined by R13 and C4 through D1. Second, pin 7 "resets" R3 and C10 for the next clock cycle.

The interval between $t_1$ and $t_2$ is an important timing interval, because it determines the clock speed and guarantees uniform clock pulses and character spacing. At $t_1$ the period $t_2 - t_1$ is governed by the time constant $R_T C4$, where $R_T$ = R13 + R12 and by the 555, pin 2. Since D1 isolates the positive voltage on the charged capacitor, C4, from pin 3, the only discharge path is through the timing

Fig. 1 — Timing diagram for the dot-memory keyer (see text).



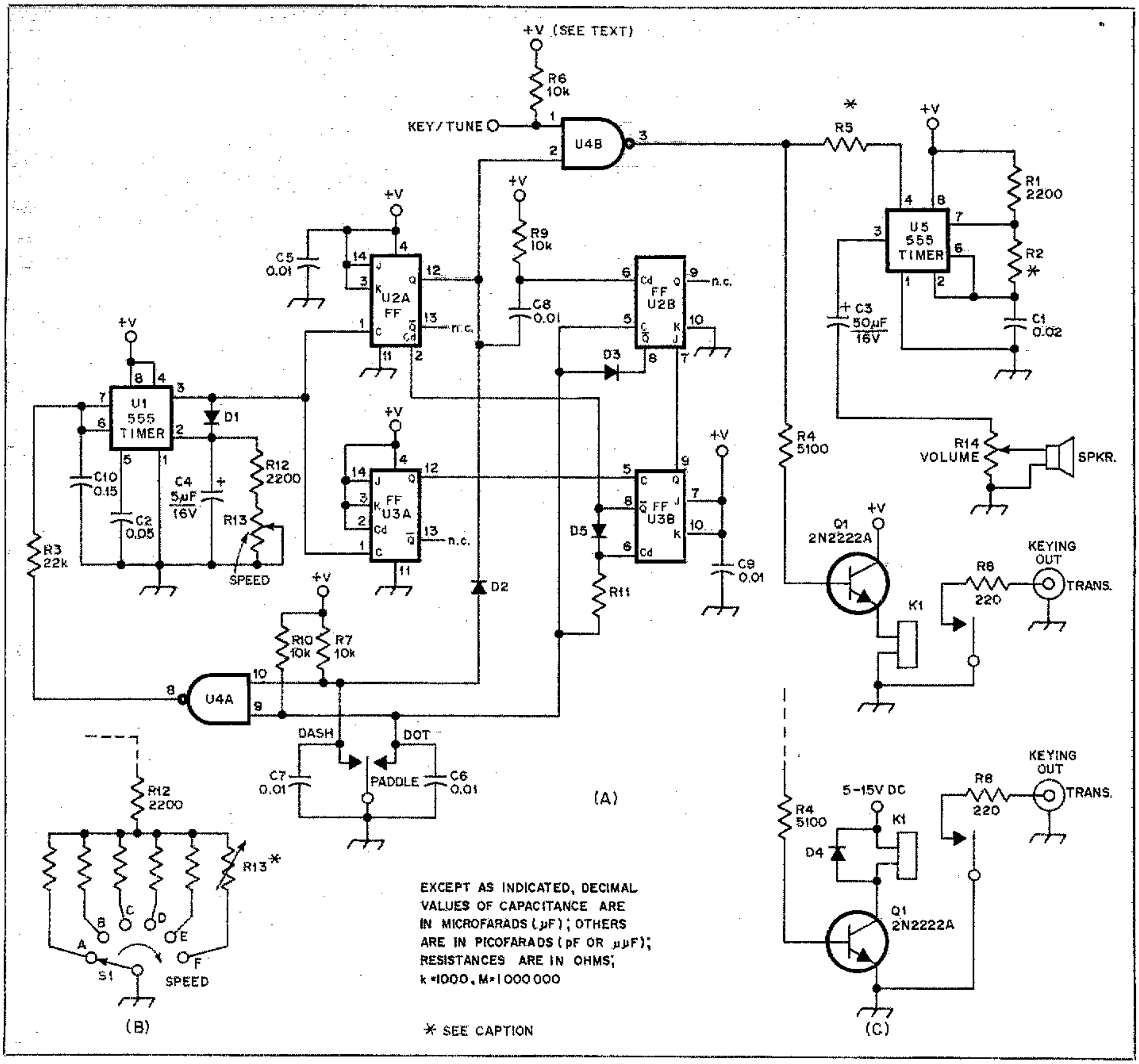



Fig. 2 — Schematic diagram of the low-cost, dot-memory keyer. Shown at B is an alternative speed-control arrangement, which may replace R12 and R13 at A. C shows the suggested circuit for reed relays requiring a higher coil voltage (see text). All resistors are 1/4 watt. Capacitors are disk ceramic except for those with polarity marked, which are electrolytic. Parts not listed below are identified on the diagram for aid in parts placement.

D1, D2, D3, D5 — 1N191, 1N4001 or any silicon diode rated at a minimum of 10 mA at 15 V.
D4 — Silicon rectifier diode, 1N4001 or equiv.
K1 — Any 5- to 12-V reed relay (see text).
LS1 — Any 8- to 40-Ω speaker.
R2 — 39 kΩ fixed, or 50 kΩ variable for tone adjustment.
R5 — 47 kΩ to 150 kΩ; see text.
R11 — 470 Ω (TTL) or 15 kΩ (CMOS).
R13 — 50 kΩ variable (reverse audio taper if available) or for option B:
R13A — 45.8 kΩ for 5 wpm.
R13B — 19.8 kΩ for 10 wpm.
R13C — 12.4 kΩ for 15 wpm.
R13D — 8920 Ω for 20 wpm.
R13E — 5300 Ω for 30 wpm.
R13F — Same as R13 above.
R14 — 1000-Ω variable, audio taper if available; linear taper suitable.
S1 — 6-position slide or rotary switch.
U1, U5 — 555 timer IC.
U2, U3 — 7473 TTL or 74C73 CMOS dual J-K flip-flop IC.
U4 — 7400 TTL or 74C00 CMOS quad 2-input NAND gate IC (2 sections unused).

resistance, $R_T$. Pin 2, the trigger input, sets the output of the 555 high when the capacitor voltage drops below one-third Vcc. The cycle then repeats itself after resetting of the 555 at $t_2$.

U5 is also a 555 timer. This is a more conventional application of the 555, making use of its capability to provide up to 200 mA of current for driving the speaker. R2, between pins 6 and 7, can be selected for the operator's preferred tone pitch or may be replaced by a pot for changing the tone at will. R5 virtually eliminates the sidetone clicking normally encountered with gated oscillators. Its optimum value will depend on the supply voltage.

Two output keying circuits are offered, the choice depending upon your approach for providing the reed relay. The circuit shown in the main diagram of Fig. 2 is particularly suitable if one winds his own reed-relay coil. By winding coil resistances of 100 to 200 ohms with fine coil wire on miniature relays, one obtains a satisfactory circuit combination. However, for those who purchase a commercial reed relay with existing coils, the rated coil voltages are usually above 5 volts. The circuit of Fig. 2C, using the common-emitter amplifier, allows any voltage reed relay which is connected to an appropriate supply voltage to be used.

The alternate timing resistor arrangement shown in B of Fig. 2 offers one set of values for a six-position stepping switch; the sixth position of the switch allows conventional analog control of the keying speeds.

## Packaging

Let your imagination be your guide in packaging this keyer. The small size of integrated circuitry offers remarkable savings in package size compared to vacuum tubes or discrete components. The photo illustrates several alternate methods of packaging used by the authors. Ready-made circuit boards are available.[1]

Because the CMOS and 555 integrated timer chips can operate from between 5 and 15 volts, the power supply possibilities are varied. Operating mobile suggests use of the auto's supply. A battery pack, dc adapter, or simple dc supply are other possible power sources.

The photo also illustrates various physical enclosures. Homemade scrap aluminum and contact paper are useful items. Dry-transfer labeling adds a professional touch. Finally, placement of controls, jacks and labels is up to the individual constructor. However you do it, the result will be *you*.

[1]For those wishing to avail themselves, ready-made circuit boards are available from William Vancura, 4115 35th Ave., Moline, IL 61265. Enclose an s.a.s.e. with your request; price is $4.

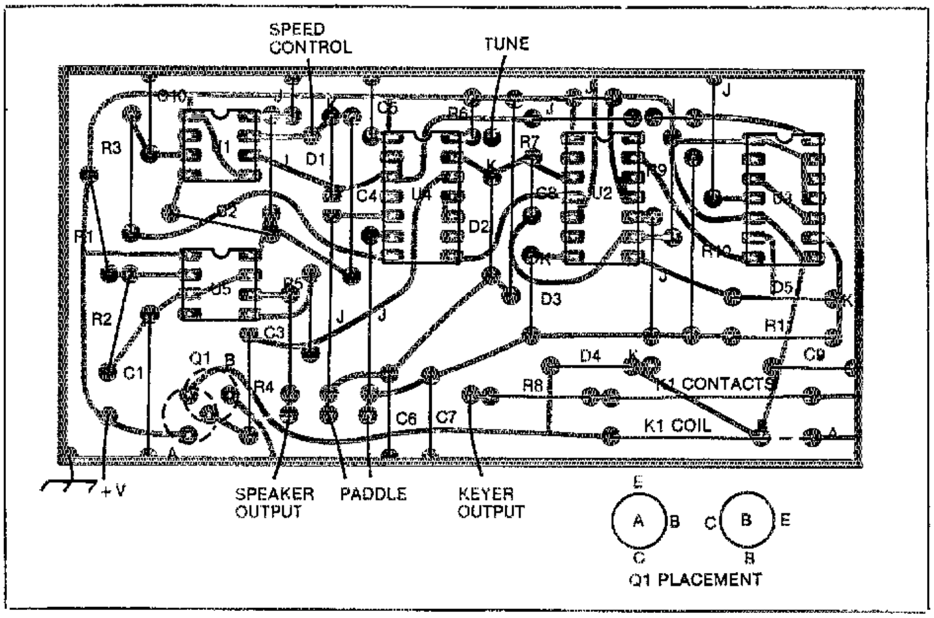
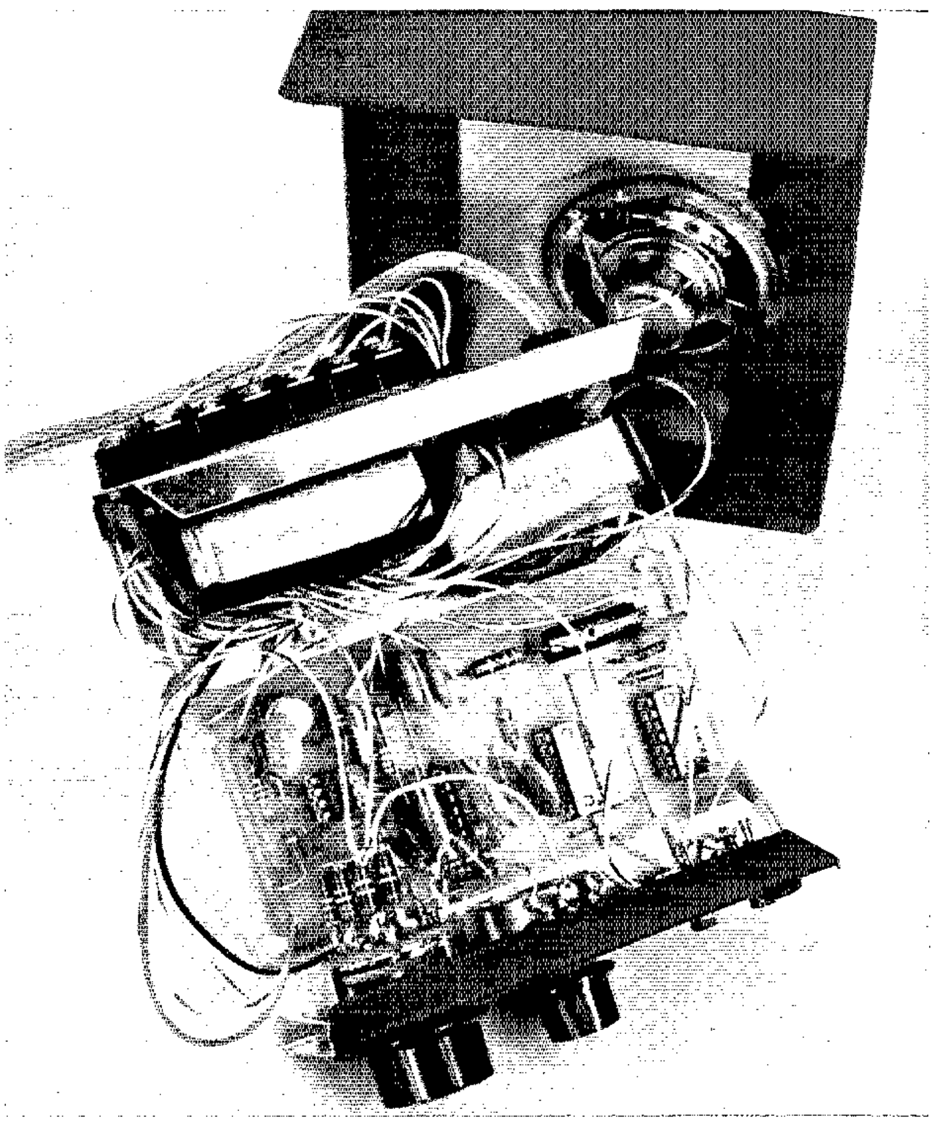



Fig. 3 — Actual size pc-board template for the dot-memory keyer. The pattern is shown from the foil side of the board, with the shaded area representing copper. J = wire jumper; K = cathode. The board pattern will accept installation of Q1 and K1 for either emitter-follower operation (A), or common-emitter amplifier operation (B). See text.

Interior view of one version of the keyer. Note that leads to the circuit board are left long, to allow the board to be lifted from the cabinet without disconnecting it.



Even if you use ready-made circuit boards, there's plenty of opportunity for originality in packaging this keyer. Here are three different versions constructed by the authors.