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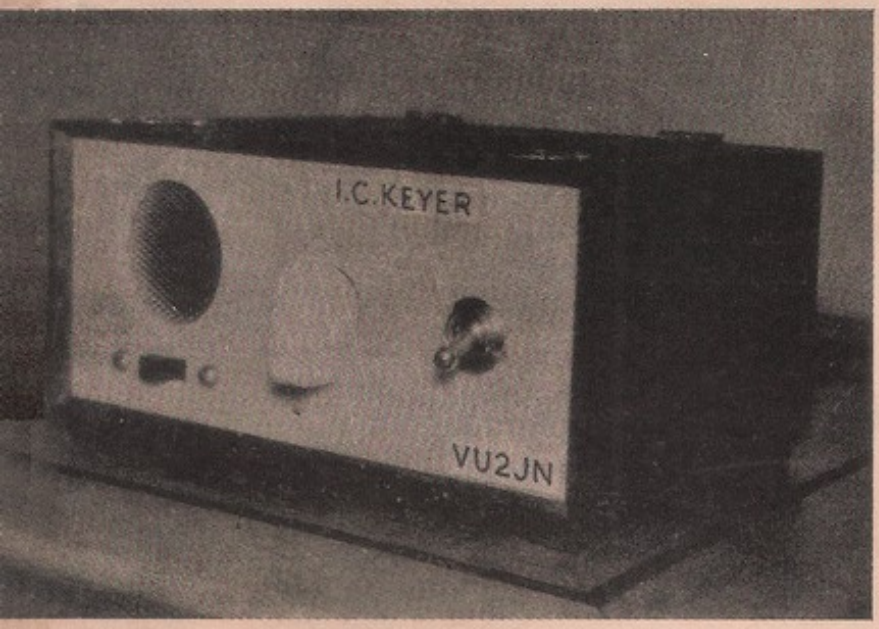
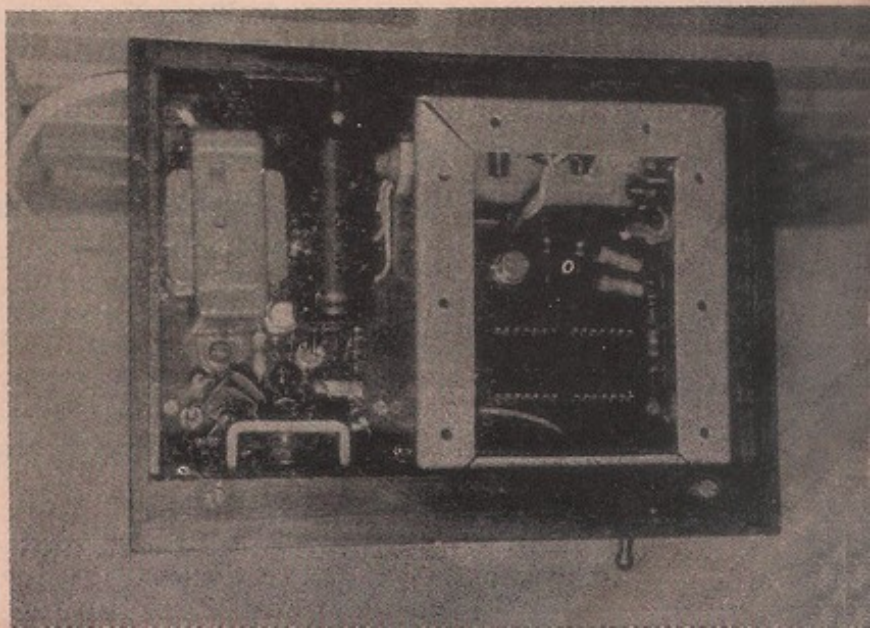


VU—air stirred for the first time when Vikram Sondhi VU2QR built his electronic keyer designed around CIL transistors in 1968. VU2QR was followed next by Lakesh Khanna VU2LO.

★

VU—air is strirred again for the third time with ELECTRONIC KEYER built around Integrated Circuit, for the first time by R. Jayaraman VU2JN, in 1969.

Details in the next issue !



I. C. KEYER

By R. Jayaraman *, VU2JN

Introduction :

Integrated circuits (I.C.) have revolutionized many fields of electronics. Of particular interest to the radio amateur is the fact that I.C.'s are now used extensively in the construction of electronic keyers, in view of their low cost, ruggedness and ease of adaptability to varied digital logic. A number of articles have recently appeared in the leading ham magazines describing several I.C. keyers. One of the simplest of these is the keyer described by Richard P. Halverson W0ZHN and Ronald A. Stordahl K0UXQ in QST for April, 1968.

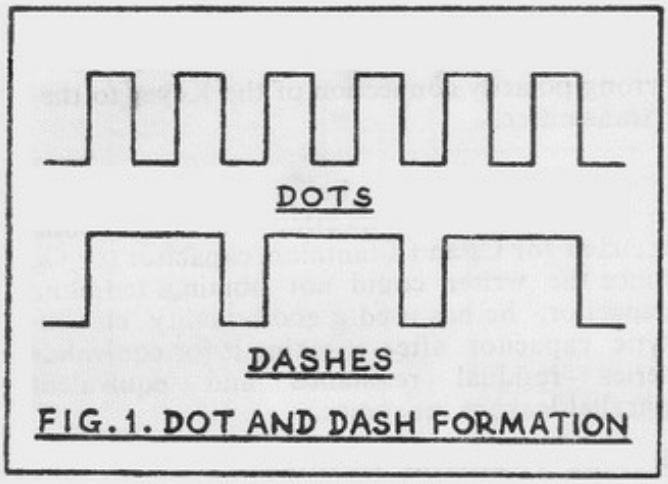


FIG. 1. DOT AND DASH FORMATION

The circuit features perfect dot and dash formation (fig. 1) irrespective of the speed control setting. Both dots and dashes are self-completing, which means that if the key lever is momentarily pressed to a side and released, a dot or dash of only the correct length will come out.

The circuit :

The keyer circuit (fig. 3) uses only three I.C.'s: one each of Motorola Dual J–K flip-flop (MC790P); Quad 2-input gate (MC724P) and Hex inverter (MC789P). The writer has not come across any other circuit that is so economical in the use of I.C.s and transistors. MC790P features two separate J-K flip-flops (fig. 2); MC724P features four separate 2-input gates and MC789P features six separate inverters. The reader is referred to the article 'An Integrated-Circuit Electronic Keyer' in QST, April, 1968, for a detailed presentation of the schematics of the I. C.'s and the logic of the keyer. * However, if the writer's experience is any indication, an understanding of the logic of the keyer is not essential for successful construction of the keyer !

With the circuit values shown, the range of speed of the keyer is 6 to 45 w. p. m. Other ranges can be obtained by changing R_1 and R_2. Incidentally, the code speed in w. p. m. can be obtained by counting a string of dashes for a minute or so.

$$\text{Code speed in w.p.m.} = \frac{\text{Number of dashes/min.}}{12.5}$$ **

Construction :

The complete keyer, including the power supply and monitor, is built inside a $6'' \times 4\frac{1}{2}'' \times 3''$ rosewood cabinet with a sky-blue perspex panel. The keyer proper is built inside a fully shielded aluminium box to avoid the possibility of keyer malfunction due to RF pickup.

Referring to the front-view of the keyer the controls to the right of the speaker are the speed control and the on/off switch. Below the speaker is a slide-switch for switching the monitor on or off. Referring to the top view, the keyer proper is in the aluminium box at right, while the

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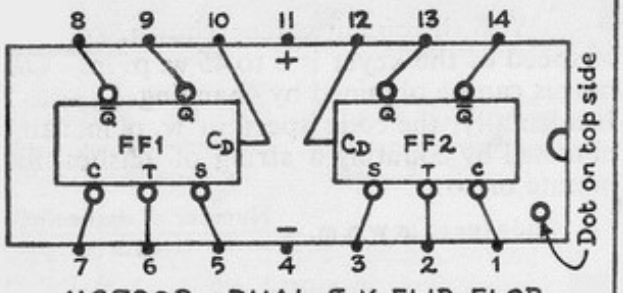
* Each gate of the MC724P utilises two transistors and three resistors; each inverter of the MC789P utilises one transistor and two resistors; and each flip-flop of the MC790P utilises twelve transistors and sixteen resistors. Together, the three I.C.s represent the equivalent of 38 transistors and 56 resistors.

** For determining the speed of Morse code in words per minute, the international standard word is PARIS. The word occupies 43 bauds or space units, followed by a word-to-word space of 7 bauds.

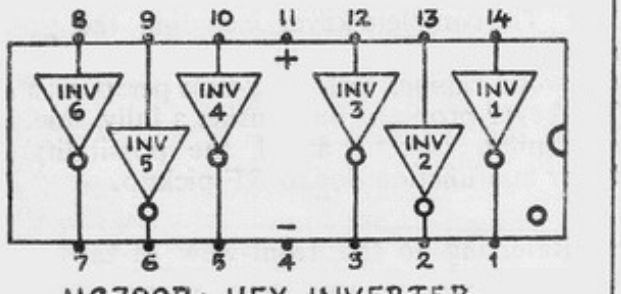
power supply and monitor are at the left. Four I.C.'s are visible in the photograph. Since the writer could not obtain a Hex inverter, he has used six out of the eight gates available in two Quad 2-input gates as inverters, leaving one input of each gate unused.

The entire keyer circuit is wired on a $2\frac{3}{4}'' \times 2\frac{1}{2}''$ bakelite board. A 0.04" drill was used for drilling the holes (14 for each I.C.) in the board for mounting the I.C.'s. A 15-watt miniature soldering iron was used to solder the wires to the I.C.'s.

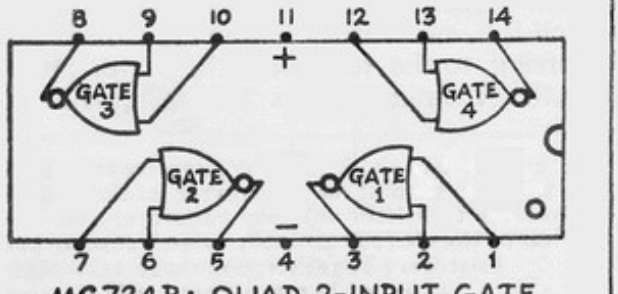
Five banana sockets have been provided for connections to the transmitter and the paddle-key. A reverse-biased 400 PIV silicon diode with high back-resistance is connected



MC790P : DUAL J-K FLIP-FLOP



MC789P : HEX INVERTER



MC724P : QUAD 2-INPUT GATE

FIG. 2. BOTTOM VIEWS OF I.C.s

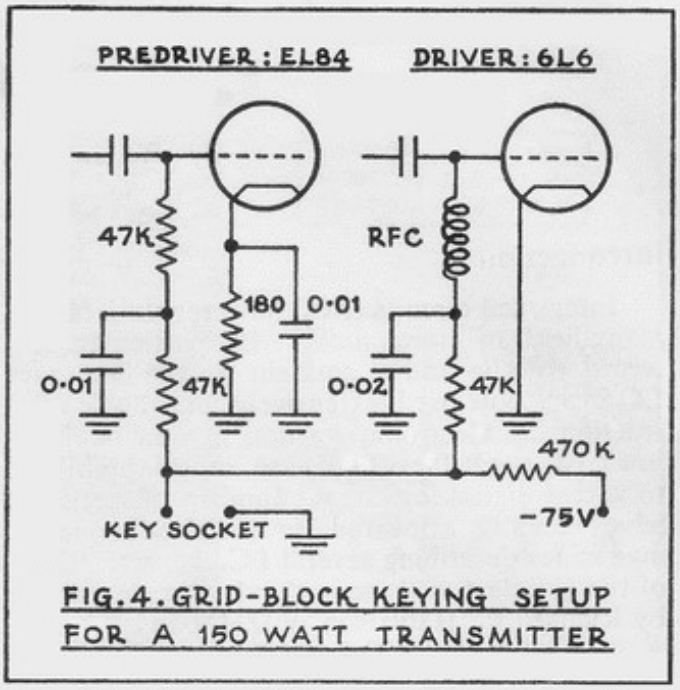


FIG. 4. GRID-BLOCK KEYING SETUP FOR A 150 WATT TRANSMITTER

across the output sockets to protect the 2N1234 keying transistor, in the event of wrong-polarity connection of the Keyer to the transmitter.

C_1 and C_2 should be good-quality capacitors. A ceramic capacitor has been recommended for C_2 and a tantalum capacitor for C_1. Since the writer could not obtain a tantalum capacitor, he has used a good-quality electrolytic capacitor after checking it for equivalent series residual resistance and equivalent parallel leakage resistance.

Deluxe Transistor Keying :

The best system of keying the transmitter is solid-state grid-block keying, eliminating the keying relay and along with it the possibility of relay-contact-bounce, sluggishness at high speeds, etc. Several high-voltage PNP silicon switching transistors such as 2N1234, 2N398 and 2N4888 are now available and will stand upto 150 volts collector-emitter voltage.

The writer has used a 2N1234 transistor for keying the grid-block line. The P.A. in the transmitter is run as a linear with adjustable fixed bias and grid-block keying is applied to the driver and predriver stages (fig. 4). The blocking voltage is −75 volts, taken from the regulated bias supply of the P.A. in the transmitter. In the OFF state, the col-

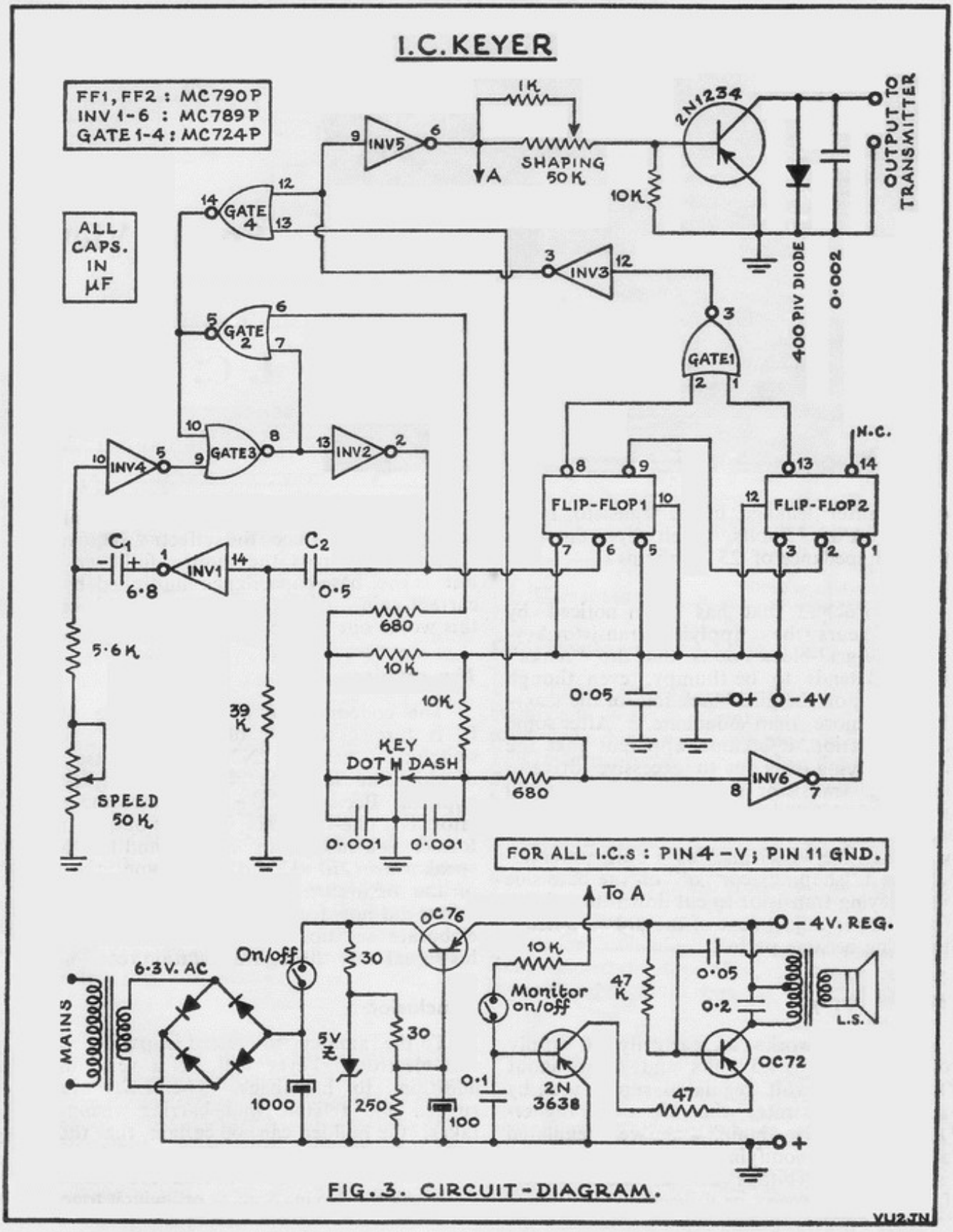
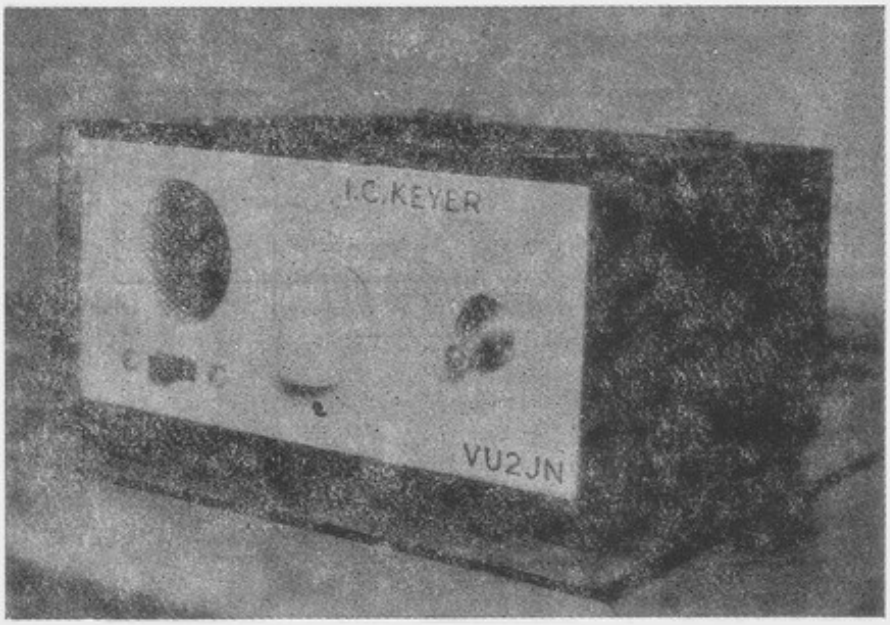


FIG. 3. CIRCUIT-DIAGRAM.

VU2JN



Front - View of I. C. KEYER

lector emitter leakage of the transistor is as low as 3 μA at 75 volts, which represents an effective impedance of 25 meghoms.

One problem that has been noticed by many amateurs when applying transistor keying to the grid-block line is that the "make" sometimes tends to be thumpy, even though the shaping on the gird-block line of the transmitter is more than adequate. After some experimentation, it became apparent that the thumpy keying was due to excessive drive to the keying transistor and the extremely small value of the keyed current (about 150 μA), resulting in jerky turn-on of the keying transistor. Then the writer inserted a 50K potentiometer as a "shaping control" on the base side of the keying transistor to cut down the drive. With proper adjustment of the potentiometer, the keying became perfect.

Power Supply :

The keyer works satisfactorily at supply voltages of 3.5 to 4.5 volts and draws about 60 mA. The 4 volt regulated supply used by the writer illustrates the use of a higher-voltage zener for obtaining a lower regulated voltage. By modifying the values of the resistors in the voltage divider chain, zeners of other voltages may be utilised.

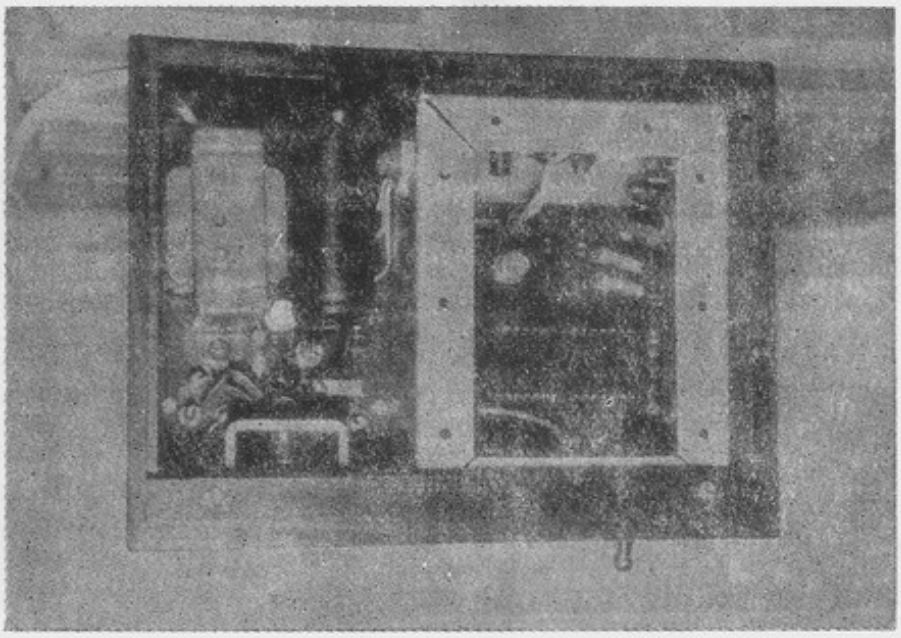
The regulator also features capacitance multiplication, since the effective equivalent capacitance across the emitter-follower output is the base-capacitance multiplied by the current-gain β of the transistor. In this circuit this works out to about 6000 μF.

The monitor :

The code-monitor is a very simple affair. It is turned on and off by a PNP silicon switching transistor 2N3638, to the base base of which the negative pulse from the keyer is applied. Because of the facts that the oscillator is a one-transistor job, the output transformer is a subminiature type and the loudspeaker a small $1\frac{1}{2}''$ Japanese type, the tone of the oscillator is not very pleasant. The writer did not feel it necessary to have a more elaborate set up, since he nomally monitors his signal only through the station receiver.

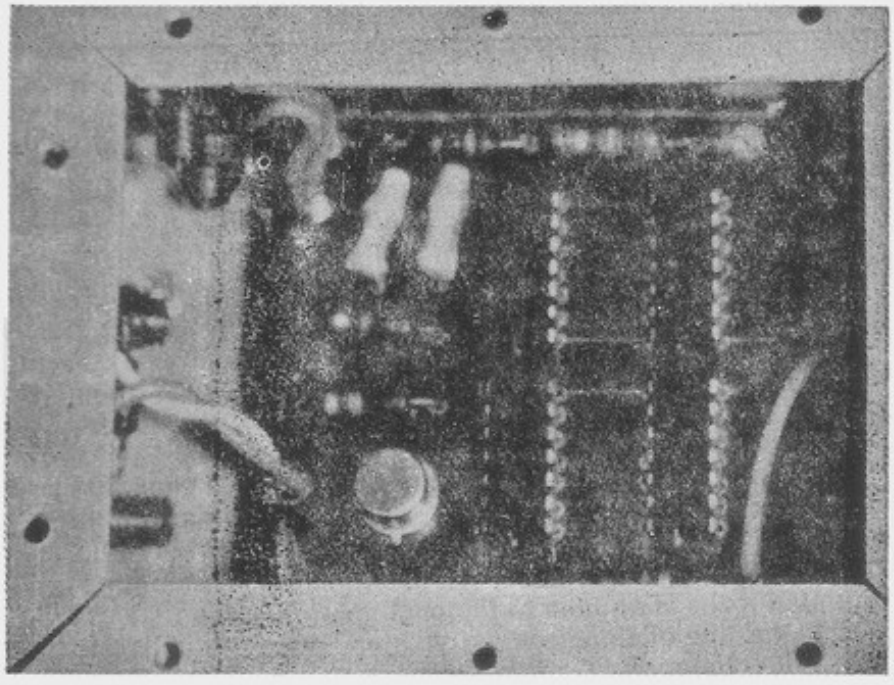
Conclusion :

To the amateur interested in perfect code, this electronic keyer will be a very useful addition to hamshack. The I.C.s are so rugged and reliable that, barring wiring mistakes, the builder can be certain that the rig will work alright. The only essential components that are to be imported are the three I.C.s and the keying transistor, which together



Top - View of I. C. KEYER

Inside - View of the I. C. KEYER Compartment



cost less than 6 dollars in U.S.A.

It is hoped that this article will inspire many more Indian hams to get interested in I.C. keyers.

—VU2JN.