THE ZEDEL KEYER

by Jamie Pye ZL2NN from information supplied and prepared by Alan Dawson ZL2JZ.

Presenting another keyer is a real problem owing to the large numbers of circuits published during the last few years. However, after trying several circuits of relative simplicity, difficulty was still found at higher speeds of sending. An endeavour was then made to find the cause. For this purpose the sending faults had to be identified. After listening to other amateurs using known keyers it became very obvious the cause was primarily a matter of timing during manipulation of the paddle. This subject alone could fill an article in Break-In.

After going back through available literature over the last few years the desireability or otherwise of memories for dots and dashes could not be determined. Search where you will through QST and other magazines but no firm stand has been followed laying down good reasons for or against memory circuits in the standard run of keyers. Some articles were for, while some were against and could see no reason for including them. After setting up some code in diagramatic form it become obvious and was clearly demonstrated that a memory cirucit or circuits for both dots and dashes provided the necessary leeway to enable an operator sending at his best speed to avoid or drastically reduce sending errors.

This has been found to be so in practice and provided the necessary proof. Many circuits have used various types of pulse generators and square wave generators, including multivibrators to produce the necessary control voltages, some good, some bad, many tricky. The best type had to be sorted out. Gating circuits ranged from simple to complex. The actual keying circuit itself was also wide open to debate. Skipping a great deal of interesting argument some final conclusions were arrived at as follows:

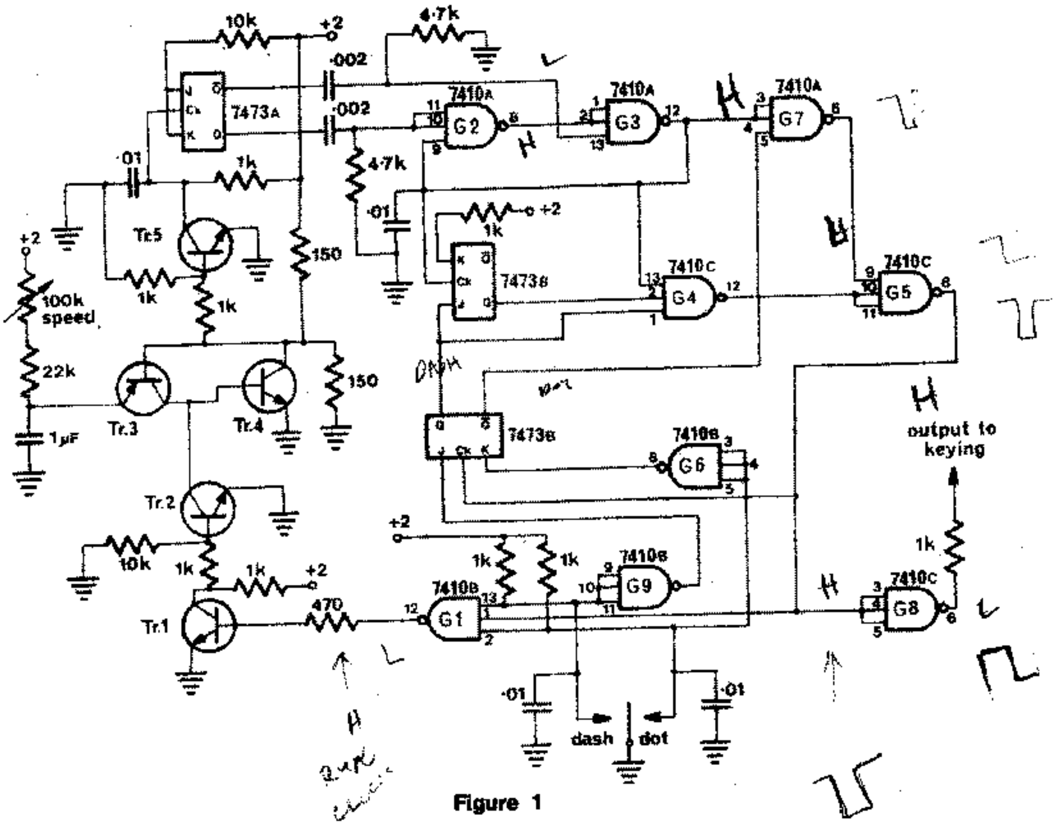
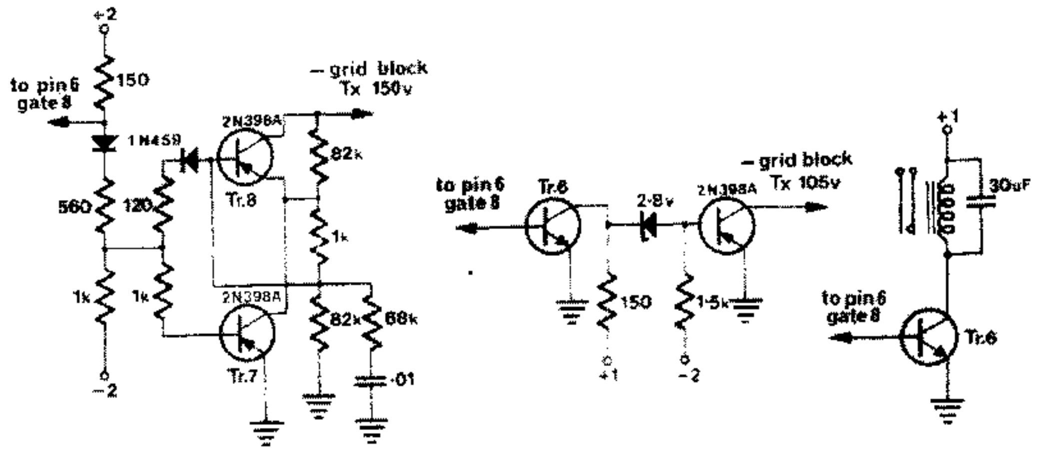


Figure 1



Suggested Keying Circuits. (Figures 2, 3 and 4).

1. The clock signal must have an instant start and cover a wide speed change without distortion.

2. The gating circuit should be adequate without undue complexity. A dot and dash memory must be included thus enabling a squeeze key or double paddle to be used so permitting any morse character to be sent by two finger movements. Such a circuit can also be successfully used with a single paddle and will improve the sending of the best operators.

3. The output circuits should be easily adaptable to transistor or relay keying. Note when using a relay just any old relay won't do.

4. All parts used must be readily available in ZL land, and TTL blocks were a necessity.

The circuit shown in Fig. 1 is the one finally settled on and is in fact number six in a series of experiments. It meets all the requirements detailed above and has the added advantage of simple circuitry, easily obtainable parts and low paddle contact current. Also the circuit is not particularly critical of supply voltage and will operate from a battery or on AC with an additional power supply.

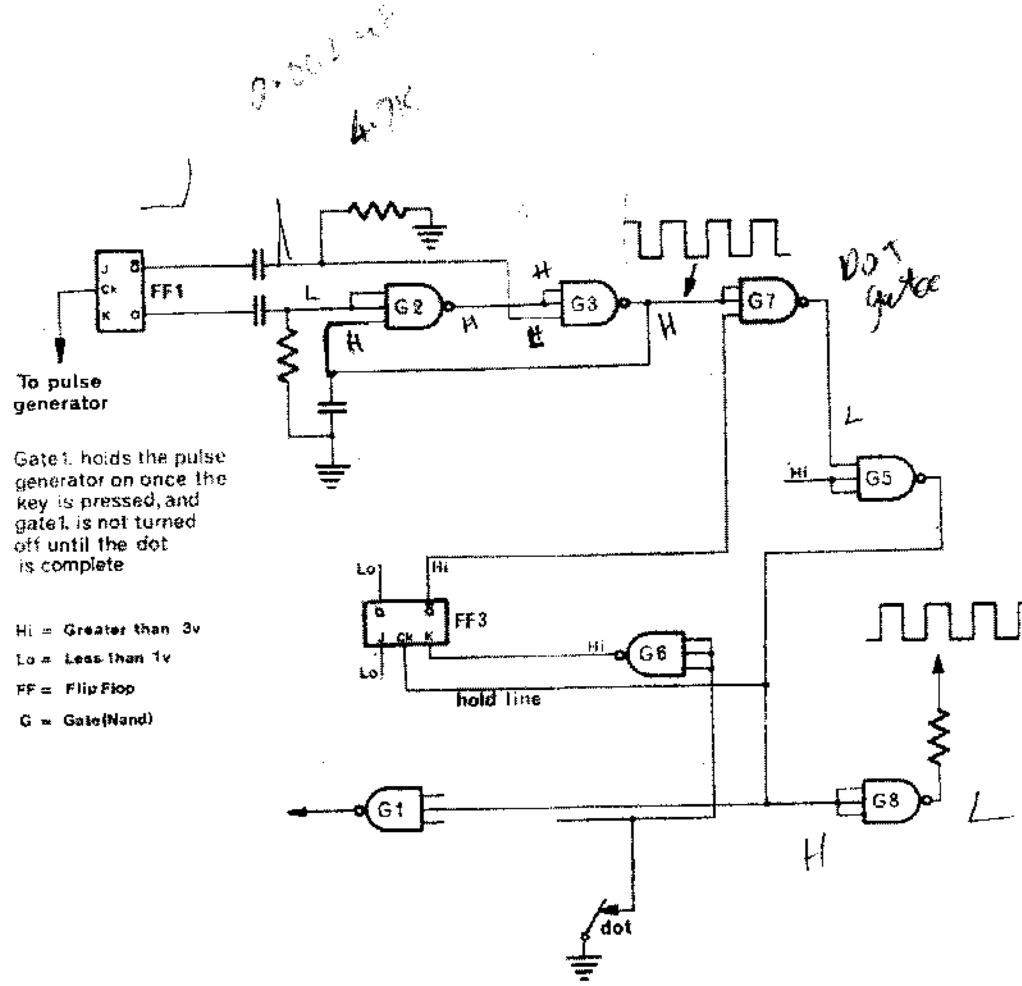
The gating circuit requires a square wave for correct operation and this necessitates some care in deciding which circuit can best meet the requirement of instant start and constancy of waveform over the whole speed range. These two factors can make or break a keyer. After surveying the available literature over a number of years and trying a number of circuits only one was found to perform with stability and precision in a relatively simple form free of any trickery.

Technical Description

The circuit shown in Fig. 1 consisting of transistors TR 2, 3 and 4 was published in QST August 1967 under the title of "The Micro-TO Keyer" by Chet Opal K3CUW.

This is purely a pulse generator and not a square wave generator. Its operation is as described below with Opal's original explanation followed as far as possible.

Ignore TR2 for the moment and this leaves TR3 and TR4 resembling a unijunction transistor. Both TR3 and TR4 are normally off and the base of TR3 sits at about 1.5 volts as determined by the 150 ohm divider resistors between + 2 and ground. The 1μF capacitor at the emitter of TR3 charges through the speed control, a 100k ohm variable, and the 22 k ohm resistor in series until the TR3 emitter reaches about 2.1 volts at which point TR3 begins to turn on. Current begins to flow into the base of TR4 and also commences to conduct. This lowers the base voltage of TR3 making it turn on a little more. TR3 then feeds more current to TR4 increasing its conduction and so on until TR4 discharges the 1μF capacitor and thus a negative going pulse is produced. When there is not enough charge on the 1μF capacitor to keep things going TR3 and TR4 turn off. The base of TR3 goes back to 1.5 volts and the whole process repeats. Now getting back to TR2 and putting it into the circuit it can be seen that with the key levers open it is normally conducting and since the collector-emitter voltage on a saturated silicon transistor is less than the base-emitter drop required to turn it on it diverts any current that would otherwise go into the base of TR4. The collapsing process cannot begin



ZEDEL Keyer Dot Formation (Figure 5)

and the capacitor is clamped at about 2.1 volts by the base-emitter divide of TR3. The instant the dot or dash lever is closed TR2 is turned off allowing a pulse to be produced by TR3, TR4.

The pulse generator as shown in Fig. 1 has the additional transistors TR1 and TR5. These were found necessary to obtain the necessary pulses and control voltages for the TTL IC's used.

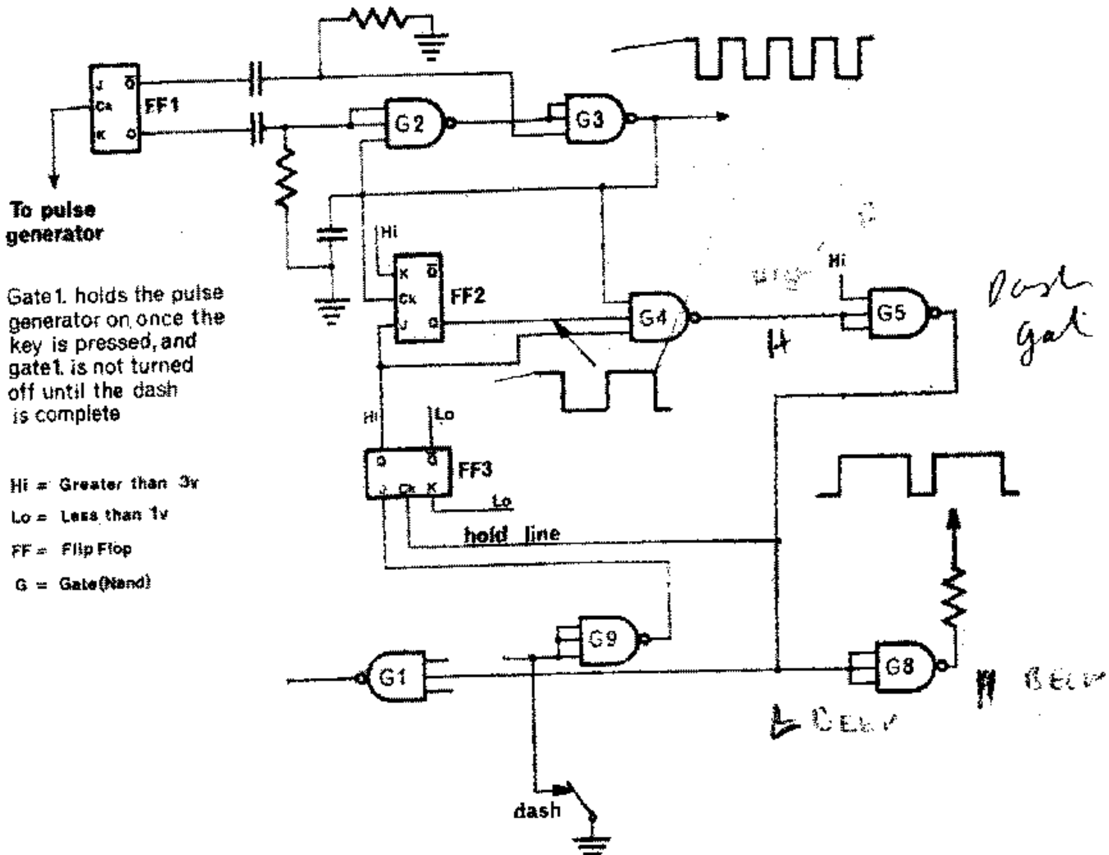
TR5 inverts the negative going pulse into a positive pulse to drive the clock input — Ck of 7473A flip-flop. Successive positive pulses to Ck reverse the output of the flip-flop thus presenting a precisely formed square wave to the inputs of the gate circuits through the two .002μf capacitors, connected to pins 8 and 9 of the 7473A (A is not part of the part number—only a circuit reference).

The original speed claimed for this pulse generator was 8 to 50 wpm, but in practice it has been found to exceed this. There appears to be no practical reason why it should not reach at least 60 wpm if anyone is in a hurry!

Now going through the complete operation of the circuit. On either key being pressed (dash or dot) the output of Gate 1 (G1) gives high—almost to the supply voltage on + 2. Forward bias is supplied to TR1 and it conducts. The forward bias is removed from TR2 because the voltage on the collector of TR1 falls to a low value. The pulse generator starts up causing flip-flop one (FF1) to change states with each pulse. As long as either key is pressed the above condition occurs.

Referring to Fig. 5 shows the signal and control paths for the dot formation. Flip-flop one drives gates G2 and G3 which produce a sufficiently steep edge to the pulses to clock the other two flip-flops. When the dot key is operated, gate 6 will put a high on the K input of FF3. FF3 will pass to $\bar{Q}$ and put a high on gate 7 bottom input terminal. Dot pulses are allowed to pass gate 7 which are on the other input terminals.

Q on F3 is low and through gate 4 (not shown) a high is put on Gate 5 thus allowing



ZEDEL Keyer Dash Formation (Figure 6)

the dot pulses to pass to gate 8 and to the keying circuit. FF3 and gate 1 are kept in the same state until the pulse, dot or dash is completed even if the key is up, by the feed from G5's output.

If the dash key is pressed (Fig. 6), a high appears on the J of FF3 this needs only to be a momentary pulse (anything over 20 ns!) and at the next clock pulse this FF is changed over when Q becomes high and $\overline{Q}$ goes low. A low on $\overline{Q}$ turns off the Dot Gate 7. The high on Q allows FF2 to operate. The divided output (by 2) of FF2 combined with the action of G4 gives dashes to gate 5 and thus to output circuit. A careful study of the waveforms shows the timing sequence.

Note: Transistor types appear to be non critical for TR1 to TR6 and no doubt more modern types could be used in the keying circuits. Silicon transistors should be used for TR1 to TR6.

References

Radio Communications August 1969, page 524. QST, September 1969, page 32. QST, November 1968, page 28. QST, August 1967, page 17.

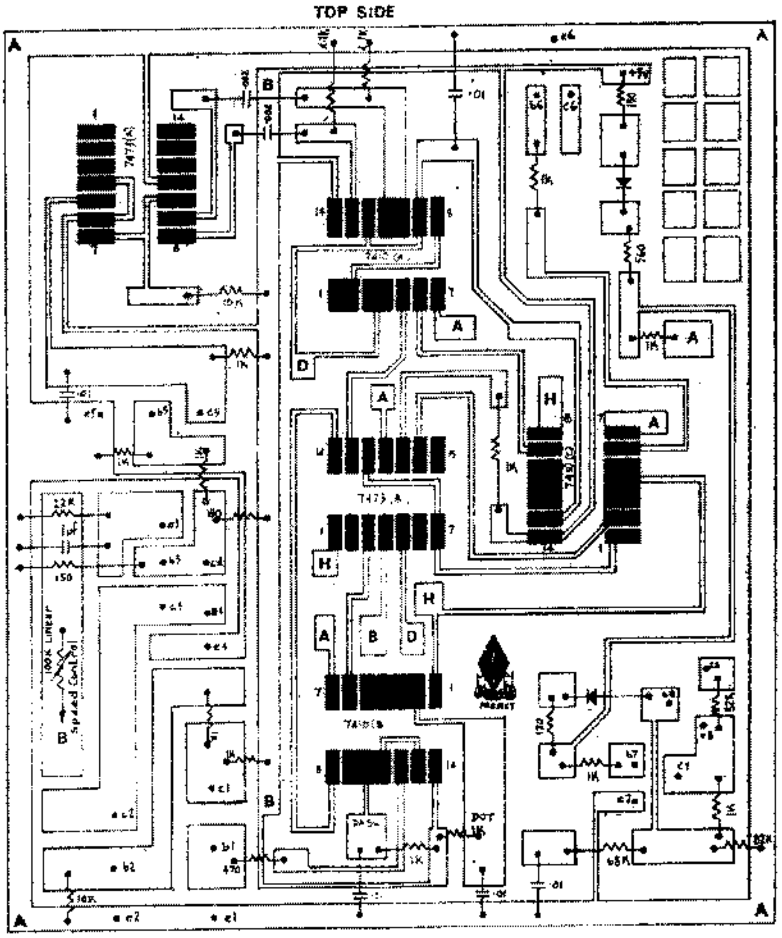
Footnote

By the time this effort is in print our version of the keyer would have been built. Going on the performance of the protoype it certainly is a keyer to end keyers, mainly because it doesn't sound like one when used even by the two below!

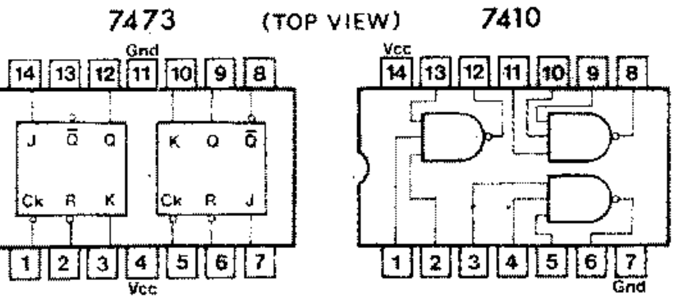
ZL2SZ, ZL2NN.

NOTICE

There will be a further series of articles from the Upper Hutt Branch (63) early 1977.



P.C. Board (actual size)



I.C. Connections for devices used in the keyer.