The $2 Infinite-Memory Keyer

Take a break. Your cassette recorder will send any message for you.

If you have a cassette tape recorder and like to operate CW, you can add an infinite memory keyer to your station for about two dollars. The idea is to place your CW messages on cassette tapes and play them back to key your transmitter. The demodulator presented in this article will convert the CW tones from the tape player into keying signals to drive the transmitter.

For repetitive messages such as CQ CQ DE . . ., you can use a continuous cassette tape. These come in 1 1/2-, 1-, 2-, and 3-minute durations. The tape in the cassette is looped back on itself and thereby forms a continuous tape. For code practice or message broadcasts, the usual C15, C30, or C60 cassettes could be used.

Code can be placed on a cassette by using an audio oscillator or your transmitter sidetone. Best results are obtained if the code is transmitted directly from the oscillator circuit to the mike input of the cassette tape recorder rather than recorded by microphone pickup. Too much background noise results from the latter.

Demodulation

Before presenting the cassette keyer, let’s look at the general demodulation process. As shown in Fig. 1, it consists of four steps: limiting, peak detecting, low-pass filtering, and slicing. The limiter is used to amplify the cassette CW tones and to provide sufficient drive for the peak detector. Also, the limiter will smooth out any small variations in the amplitude of the tones. This process is similar to FM detection ex-

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Fig. 1. Cassette memory keyer block diagram.

Fig. 2. Schematic of keyer system.

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cept that the filter or discriminator is discarded.

The peak detector is set to convert the limited tones to positive-going pulses. It acts as a half-wave rectifier but retains the positive peaks for a short duration; hence, the pulses have a slight ripple pattern at their tops. The circuit ignores the negative-going portions of the tones.

The low-pass filter is then added to remove these ripples. The system will work without the filter as long as input tones are clean and strong. It aids operation, however, when tape output is marginal.

The slicer converts the peak-detected pulses into TTL-compatible signals that go from 0 volts in the off state to about 3.5 volts in the on state.

Circuit Schematic

Now, let’s examine the circuit schematic, Fig. 2. All of the signal processing is done with a single operational amplifier chip, an LM324, which contains four separate op amps. The circuit can be operated from a 5- or 9-volt dc supply. All resistors are 1k, 10k, or 100k, with the exception of one 470-Ohm resistor.

Circuit Operation

Cassette tones enter at the left and the TTL-compatible output is at the bottom right. The circuit can also drive a low-voltage relay if it is substituted in place of the 1k output resistor at pin 14.

The limiter, U1, has a gain of ten and is biased at pin 3 to one-third of the supply voltage. This bias also sets the dc voltage level at pins 1, 5, 6, 10, and 12.

The peak detector, U2, charges capacitor C1 to the peak voltage of the tones that appear at pin 5. When the voltage at pin 5 exceeds the voltage on C1 and hence also at pin 6, U2 forward biases diode D1 and further charges C1. When the voltage at pin 5 drops, U2 turns off and C1 holds its charge until the bleeder resistor, R1, discharges it. C1 and R1 are set so that the ripple at C1 is small but the pulse formed from the code signals follows the code quickly; this is always a compromise.

The ripple is then removed by the RC low-pass filter. It does a sufficient job and frees up the fourth op amp in the LM324 IC to be used as a tuning indicator.

U3 and U4 work as slicers, or comparators, and convert the pulses from the peak detector into TTL-compatible signals. A dc restore circuit could be used here as an alternative. The advantages of the slicer are that it cleans up some ripple that may still remain and generates sharp and clean rise and fall edges for the keying output. The bias for U3 and U4 is set about one volt above the bias for U1 and U2. Therefore, when a pulse is generated at U2, the voltage crosses over the bias voltage of U3 and U4, generating positive pulses at their outputs. That is, when the voltage at pin 12 exceeds the bias voltage at pin 13, pin 14 will have an output nearly equal to the supply voltage.

The output of U3 is used to drive an LED indicator. This makes tuning and circuit verification of proper operation easy. The circuit as a whole could be used for receiver CW demodulation if a CW filter is placed between U1 and U2. You may want to consider that when planning circuit construction. Happy cassette keying!