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The Confidence Builder

— a CW speedometer

So you've been building your code speed by copying signals "off-the-air"? But you can't get W1AW much because of QRW or perhaps you have to be elsewhere while the code-practice session is on? How will you ever know just how fast you are, or whether you're quite ready to face the examiner?

Why don't you try this little fun box—my "Confidence Machine"? It not only is an excellent code-practice oscillator, but it also can tell you the number of words per minute being sent or received. On top of that, it filters out pops, snorts, whistles, roars, and other background noises so that you hear only an easy-to-copy, clean musical tone. If you can get the signal at all, you'll hear only 599s from each station.

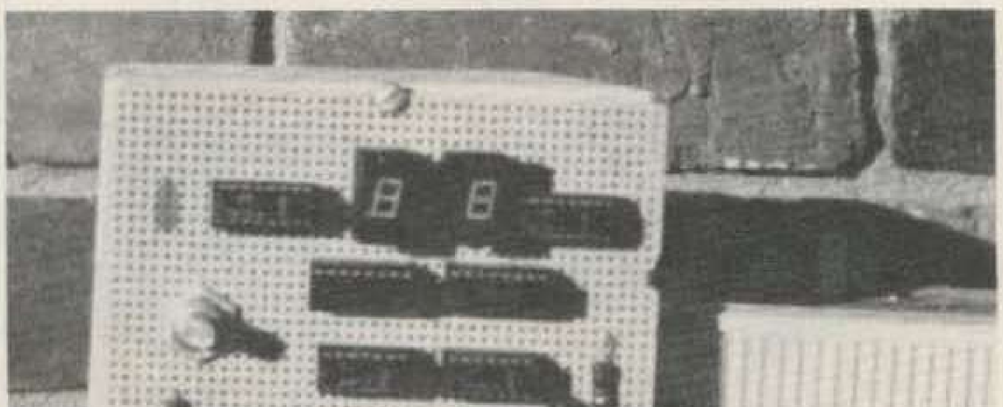

Photo A.

Even more, once the parts are assembled, this is a one-evening construction project with a cost running less than $10 if you use your junk box. The values of the resistors and capacitors are not sacred, so if your junk box has something within 25%, use it. An assumption has been made that the people most interested in building this project will be Novices or Techs looking for their General tickets. For this reason, construction details are kept as simple as possible. Also, there is no attempt at scholarly discussion about how everything works. Just build it and have fun!

How It Works—An "Unscholarly" Discussion

The Confidence Machine is a simple counter which counts the number of taps of the key and then translates the count into words per minute. In sending everyday English by Morse code, you must tap the key an average of 2½ times for each letter and 12½ times for each average 5-letter word. Count the taps for a minute, divide by 12½, and you have the number of words per minute. (Sounds like that old Texas joke about the midget who figured the number of cows in a herd by counting legs and dividing by 4!)

Design of an electronic device that will divide numbers by 12½ is complicated, but dividing *time* by the use of a 555 IC timer is easy. This means that we can divide a minute by 12½, and the number of taps during this shortened period represents the number of words per minute.

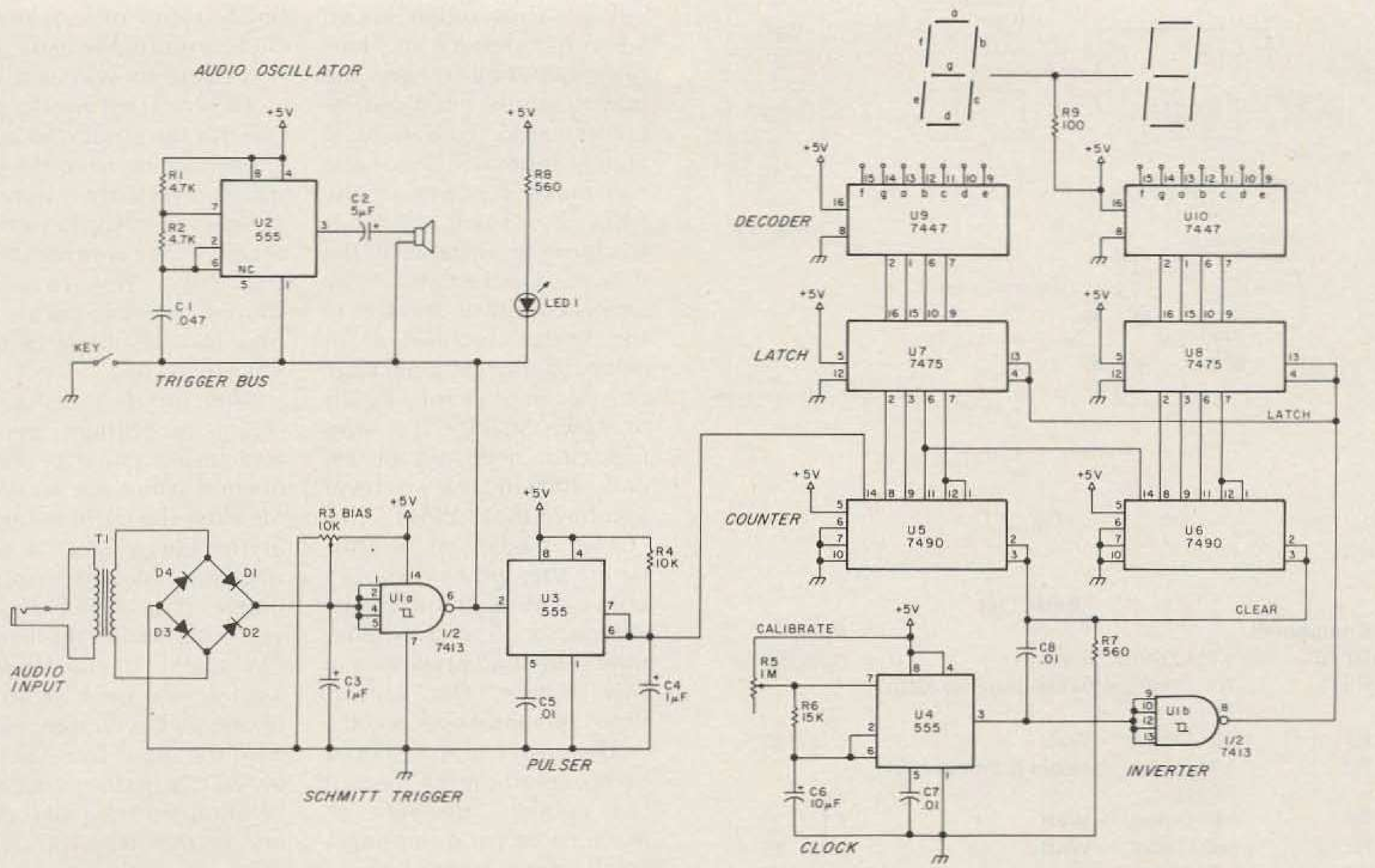

Fig. 1. The "Confidence Machine," a code-practice oscillator with code speedometer.

(Don't spend a lot of time trying to think about that, George. Just trust me and read on.)

We can count either the taps of the key or the bursts of CW tone from a receiver. If we are going to count the dots and dashes coming out of a receiver, we'll need something which will convert each burst of sound into a single electrical pulse. Since the receiver puts out varying levels of alternating current at the phone jack, we can rectify this current and apply the positive pulses to the input of a NAND gate Schmitt trigger. The Schmitt trigger can then trigger the audio oscillator and the pulser the same as a key does. (A NAND gate is an inverter. If all inputs are positive, the output is zero—it turns off. But if any one of the inputs is zero, the output is positive—it turns on.)

So, when we apply a positive pulse to the input of the NAND gate Schmitt trigger, the output drops to zero (ground), triggering both the audio oscillator and the pulser. The audio oscillator produces a tone, and the pulser produces a positive pulse which goes to the counter chain.

Each of the counter chains has a decade counter, a latch (for temporary storage of the count), and a BCD-to-seven-segment decoder (to translate the binary-coded count into a readable number in the display).

The decade counters are controlled by pins 2 and 3. They will count when either pin 2 or 3 is at ground, and they will clear when both pins 2 and 3 are made positive. In a similar fashion, the latches are controlled by their pins 4 and 13. A positive pulse at these control pins causes the latches to store or remember what the count was at the time the positive pulse arrrived. A second pulse will cause the latches to forget the previous count and store a new count.

The pulses which cause the counters to clear and the latches to store the count are generated by the clock (U4). This is a 555 IC timer set up to deliver a positive output for 4.8 seconds followed by a drop to zero (or ground) for about .1 seconds. As the output of the clock goes positive, a positive pulse is delivered to the control pins of the counters (through C8), clearing the counters. The voltage to the control pins immediately drops low through R7 and the counters are able to start counting again.

Part of the output from the clock is fed to the inverter, shown as U1B. A positive input to a NAND gate causes a zero output from the gate. On the other hand, a zero input causes a positive output. During the tenth of a second that the clock has a zero output, the output of the inverter is positive. This positive pulse is delivered to the control pins of the latches and the count is stored.

The combination of all this action causes the device to count continuously, and at the end of each 4.9-second period, it will display the count made during the previous period.

The LED tied to the trigger bus serves no really useful purpose, but it does provide visual monitoring. You may want to eliminate it, but every science-fiction movie fan knows that all computers are supposed to have blinking red lights on the front. Besides, it does look impressive when you're showing off to visitors in the shack.

Construction Hints

Construction should begin with the power supply. The requirement is for about 240 mA at 5 volts. ICs in the 7400 series require at least 4.5 volts and simply will not operate if the

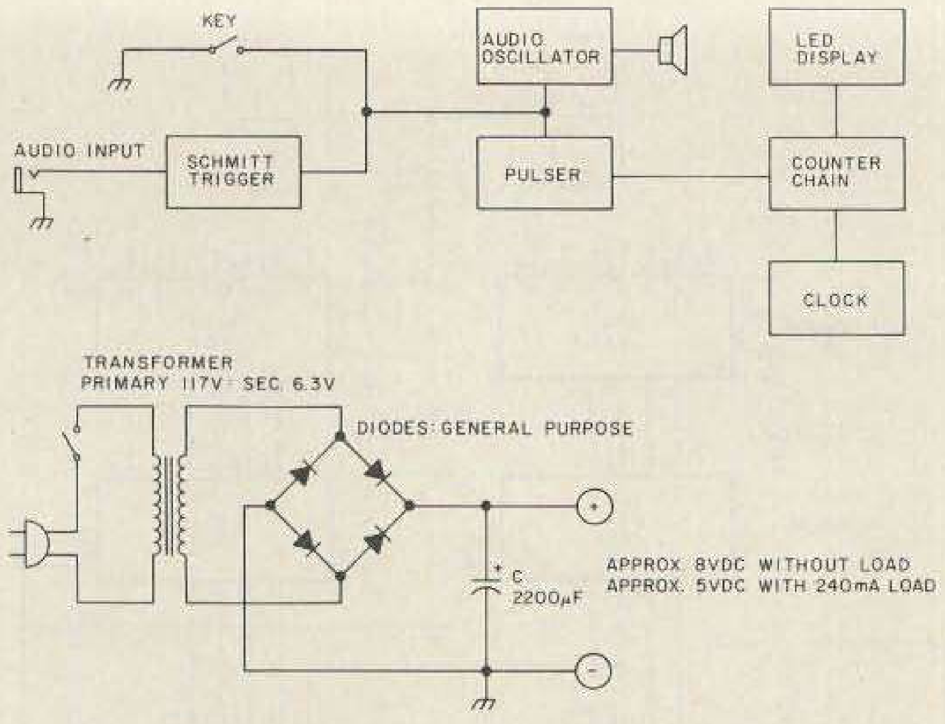

Fig. 2.

Parts List

Component		Price*
R1,R2	4.75k Ohms, ¼ Watt	5 for .25
R3	10k Ohms, variable (trimmer MDL TR11)	.35
R4	10k Ohms, ¼ Watt	5 for .25
R5	1 megohm, variable (trimmer MDL TR11)	.35
R6	15k Ohms, ¼ Watt	5 for .25
R7,R8	560 Ohms, ¼ Watt	5 for .25
R9	100 Ohms, ¼ Watt	5 for .25
C1	.047-uF disc	5 for .30
C2	4.7 uF/16 V	.14
C3,C4	1 uF/16 V	2 @ .15 = .30
C5,C7,C8	.01-uF disc	5 for .30
C6	10 uF/16 V	.14
D1-D4	diodes 1N4006	10 for 1.00
U1	SN 7413 dual Schmitt trigger	.40
U2,U3,U4	LM555 timer	3 @ .39 = 1.17
U5,U6	SN7490 decade counter	2 @ .45 = .90
U7,U8	SN7475 quad latch	2 @ .49 = .98
U9,U10	SN7447 BCD-to-7-segment	2 @ .59 = 1.18
Readouts	MAN-81 common anode	2 @ .99 = 1.98
Speaker	2"-3" Radio Shack 40-247	1.89

Options

LED 1	LED monitor may be any small LED		
Perfboard	.10 spacing 4½ × 6, Radio Shack 276-1394		1.29
Input Transformer	Radio Shack 273-1380		.99
IC sockets:	8-pin wire-wrap	3 @ .39 = 1.17	
	14-pin wire-wrap	3 @ .39 = 1.17	
	16-pin wire-wrap	4 @ .43 = 1.72	

Parts for Power Supply

Filter capacitor	2200 uF/16 V	
Filament transformer	117/6.3 V Radio Shack 273-1384	1.99
Diodes—any general-purpose diodes		

*Except where Radio Shack parts are specified, all prices are from the 1979 catalog of Jameco Electronics, 1021 Howard St., San Carlos CA 94070. (Add 5% for shipping and 75¢ for insurance. Minimum order, $5.00.) Delivery time 8-10 days.

Keep your cost down by substituting when possible. For instance, you need only one of the .047-uF disc capacitors, but you must order a minimum of five. Use the balance of them for C5, C7, and C8 instead of the .01 uF called for. Also, the Radio Shack catalog lists ½-Watt resistors at 2 for 19¢. This is a slightly higher cost per resistor, but you can buy a minimum of two.

voltage rises much above 5.5 volts. Despite this narrow operating range, the power supply need not be complicated. Four C or D cells in series will do, or you can make a power supply from a 6.3-volt filament transformer as shown in the drawing. Use just about any general-purpose diodes in the bridge rectifier. (You can probably get a package of a dozen or so for a dollar at Radio Shack.) The filter capacitor need not be exactly 2000 uF; use whatever you have that's close.

The measured output from the power supply above will be about 8 volts without a load. However, under the load presented in this device, the output drops to a little over 5 volts.

The power supply should be mounted on the base of the cabinet. Be sure to leave room for mounting a small input transformer—as will be discussed later.

Construction will be greatly simplified by using a perforated board with .10-inch spacing. The ICs can be mounted on this board without drilling. The input terminals, the speaker, the readouts, and the LED monitor will need to be mounted on the face of the cabinet. In my own construction, I used the perfboard as the face of the cabinet and mounted everything in plain sight.

However you may decide to do it, you may lay the parts out in much the same configuration as is shown in the schematic. You will need to provide for three common points of connection: a positive bus, a negative or ground bus, and a trigger bus.

Except for R5 and C6, the values of the resistors and capacitors may be varied up to 25% without seriously affecting performance. Use your junk box. I strongly recommend the use of IC sockets. They make construction and troubleshooting much easier. The wire-wrap type of socket is slightly more expensive, but it is easier to work with.

The cheapest way to provide for the input is to leave wires hanging from the two inputs which then may be connected to the key or the receiver. The wire for the input from the receiver should be provided with a plug for the phone jack of your receiver.

The input transformer (T1) is a voltage step-up transformer and may not be needed with your receiver. Measure the output voltage at the phone jack of your receiver by inserting a phone plug connected to your volt ohmmeter. Tune a CW signal. If you have at least 3 volts peak ac at the phone jack, you may eliminate the input transformer, but better performance will be obtained from all receivers if the transformer is used. If a transformer is needed, use any step-up transformer you have. I used an output transformer from an old receiver, connected backwards so that it stepped up the voltage.

The bias control (R3) and the calibrate control (R5) need be set only once, so they may be mounted inside the cabinet.

Put a 100-Ohm resistor in series with the common anode or common cathode of the LED displays. Be sure to determine whether you are using a common-anode or a common-cathode type of display before ordering your BCD-to-seven-segment decoders. A common anode requires a 7447 and a common cathode requires a 7448. Of course, the common anode is tied to the positive bus (through the limiting resistor) and the common cathode is tied to the negative bus (through the limiting resistor).

The choice of LED displays should be governed by cost and availability. The MAN-71 (red) or MAN-81 (yellow) fit nicely into a 14-pin IC socket and cost about a buck each. The FND-70 costs about 70 cents, but is available only in the common-cathode type.

Calibration and Operation

Turn the power on and rotate the bias control (R3) until a continuous sound is heard from the speaker. Then reverse the rotation of the bias control until the sound just stops. Leave the control set here.

If no tone is heard, check wiring to U1 and U2. If the volume is too low, increase the value of C2; if it is too high, decrease the value of C2. If you desire to raise the pitch of the tone, you may place another resistor in parallel with R2.

Connect a key to the key input and tap it a few times. There should be an audio output and a reading should appear. After a few seconds more, the reading should drop to zero. This indicates all systems are working.

Begin tapping the key with a steady rhythm, counting the taps for a full minute. Multiply the count by .08 and this will be the number of words per minute. (For instance, if the count is 77, multiply 77 by .08 to arrive at 6.16 or 6 words per minute.) Again tap the key with the same steady rhythm and rotate the calibrate control (R5) until the readings correspond to the computed words per minute. (Using the above example, the readings should show 6. If the machine is set perfectly, and if the timing of the taps is perfect, the machine should read 6 most of the time. But, since we obviously are not dealing with exactly 6 wpm, the reading should jump up to 7 a couple of times during the test minute.) You can get better calibration by trying several times at different speeds.

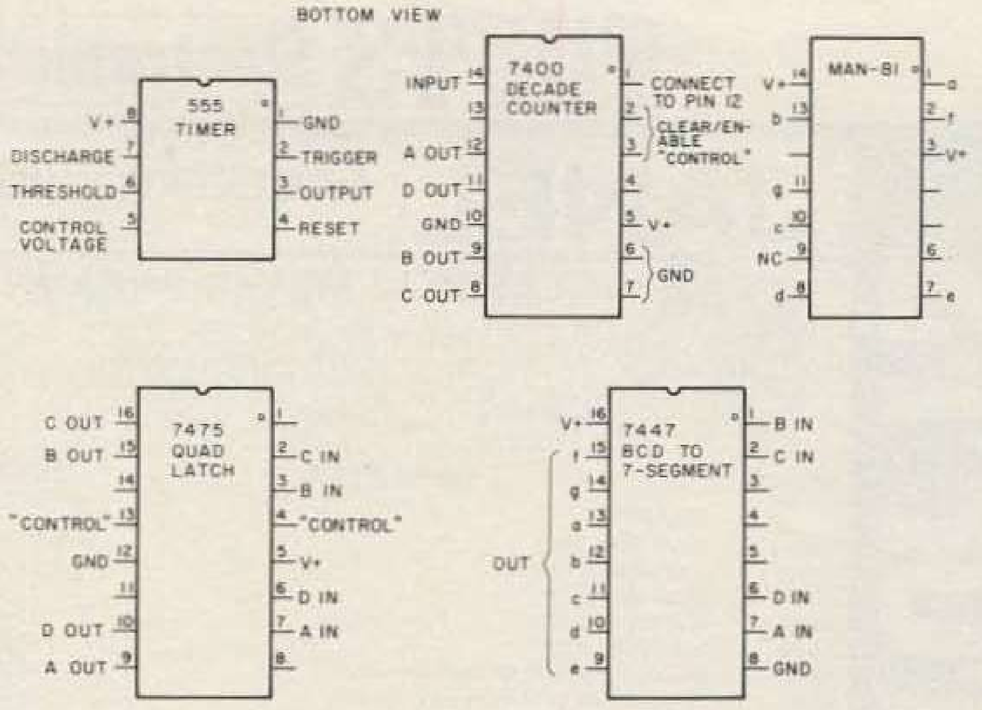

Fig. 3.

Now turn on the receiver and tune a good CW signal. Connect the receiver input of the Confidence Machine to the phone jack of the receiver. Start with the volume low and increase it until you begin hearing clean dots and dashes. Too high a setting of the volume will cause a continuous tone and also cause the trigger to be tripped by noise. This gives a false count. So keep the volume as low as possible.

The Confidence Machine is intended to be a learning tool only, and it is doubtful if it can be used in an actual QSO. However, it is fun to build and is certainly fun to use. Try it; you'll like it! ■

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