Improved QRP Keying Circuit

A slick fix for your little CW rig.

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If you've ever built a simple QRP transmitter, the keying circuit you used probably looks something like the one shown in Figure 1a. If you look at the wave shape of the RF output of your transmitter with a scope, you will see just slightly rounded edges on the signal as you key. Also, if you trigger your scope upon key closure, you will notice it takes a few milliseconds before you even get an output. Why does this happen?

Referring back to Figure 1a, when you close the key, capacitor C1 starts to discharge through resistor R1. At some point enough charge is taken from the capacitor and current starts to flow through the emitter of Q1, starting to turn it on and supplying power to your amplifiers. The amount of time it takes for Q1 to start to turn on after key closure is hard to say as the voltage across C1 does not follow the normal RC discharge curve. It only has to discharge enough to start to turn on the transistor and then the gain of the transistor modifies the curve. An additional delay is caused by the fact that the RF amplifiers don't start to turn on until there is 2 to 3 volts across them. By the time you start to get any signal out of your transmitter, a significant amount of time has gone by since key closure and Q1 is well on its way to being fully turned on.

When you release your key, C1 charges very quickly through the emitter-base diode junction of Q1. To slow down the turn off time a fairly large capacitor, C2, is added to the circuit. This gives the trailing edge of the keyed signal a shape closer to what you would expect to see. However, it takes a few milliseconds before C2 charges up enough to start to turn Q1 off, again creating a delay.

"So what?" you might ask. Well, it's not much of a problem with real low-power rigs, but when you get up to 5 or more watts of output power serious key clicks may be heard. If you try to round out the leading edge by increasing the value of C1 there will be even more of a delay between key down and signal output. This can make for clipped dots when sending at faster code speeds, making for very difficult copy on the other end of the QSO.

A Better Idea

I developed the circuit shown in Figure 1b to solve these problems for my 20 watt 40 meter transmitter.

Op amp U2b is a basic inverting amplifier with a gain of one. The capacitor C5 across the feedback resistor R11 makes it an integrator. The RC time constant of R11 and C5 determine the ramp time. The values shown will produce a 5 ms ramp. Use a good-quality capacitor for C5, such as a mylar or polypropylene type. A power transistor is placed inside the feedback loop so that the circuit can supply several hundred milliamperes of current. Control P2 sets the stand-by output voltage as seen at the emitter of Q2. U2a buffers the voltage from P2. This isolates the pot from the input of the integrator. With your key up, adjust the pot until you just start to see an output from your transmitter, then back off a little. Typically this will be between 2 and 4 volts. Your output signal will now have the proper 5 ms leading and falling edges and there will be no delay between key closure and the start of the output signal.

You must supply the op amp and collector of Q2 with at least 15 volts to produce a full 12 volts output on the emitter.

One-Chip CMOS Delayed T/R Control Circuit

In Figure 1b, when the code key is closed, the output of CMOS NAND gate A goes high, charging cap C3 through D1. The output of gate C then goes high, activating the T/R relay and the oscillator/mixer/or VFO offset. One input to gate D is slightly delayed to allow the relay and oscillator or VFO to settle before the initial keying of the amplifiers. When the key is released, the cap C3 starts to discharge through R2, P1. If the key is not closed again before C3 discharges to 1/2 of Vcc, the T/R relay will open and switch you back to receive. 73

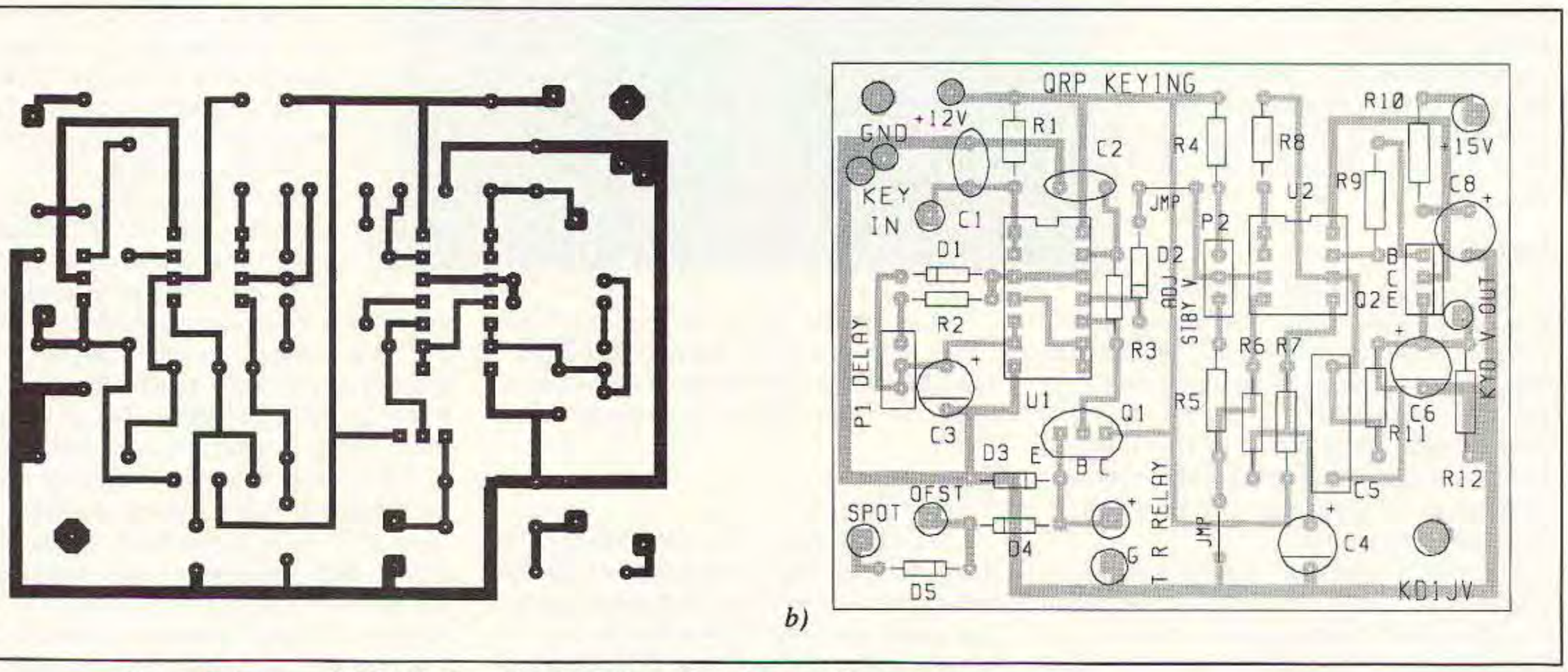

Figure 2. Improved QRP Keying Circuit PC board and parts placement diagram.

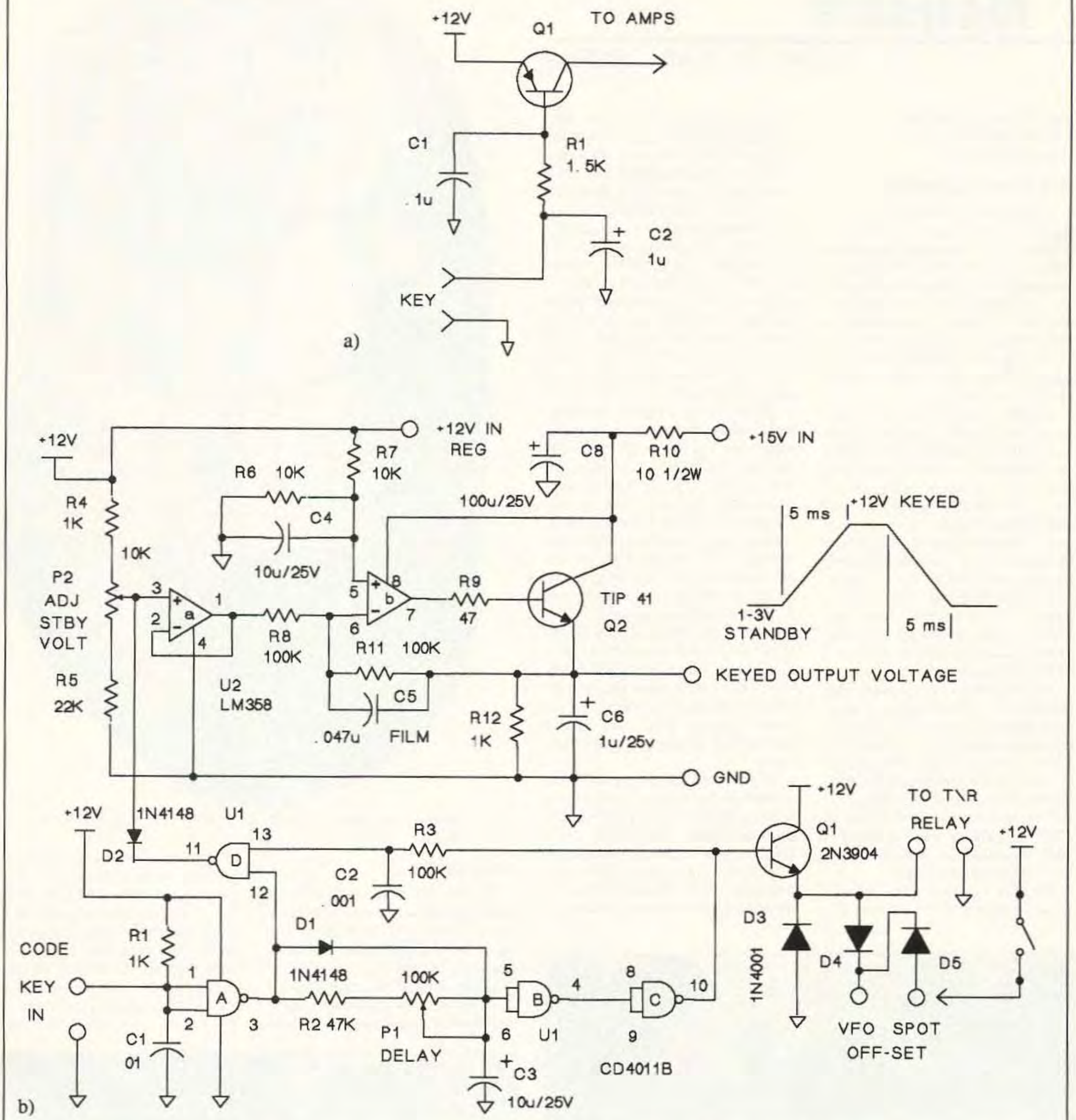

Figure 1.a) Typical QRP keying circuit; b) Improved QRP Keying Circuit with CMOS T/R keying control.

Parts List

R1,4,12	1k 1/4W	C1	0.01 µF disk cap	Q1	2N3904 NPN
R2	47k 1/4W	C2	0.001 µF disk	Q2	Tip 41-to-220 NPN
R3,8,11	100k	C3,4	10 µF/25V electro	U1	4011B CMOS NAND gates
R5	22k	C5	0.047 µF poly-film type	U2	LM358 dual op amp
R6,7	10k	C6	1 µF/25V electro		
R9	47 ohm	C7	Skipped		
R10	10 ohm	C8	100 µF/26V electro	Drilled and etched PC boards are available for $4 plus $1.50 S & H per order from FAR Circuits, 18N649 Field Court, Dundee, IL 60118.	
P1	100k or 500k trimpot	D1,2	1N4148 diode		
P2	10k trimpot	D3,4,5	1N4001 1A diode		