Novices, Paddle Your Way To Happiness

—super deluxe Novice keyer

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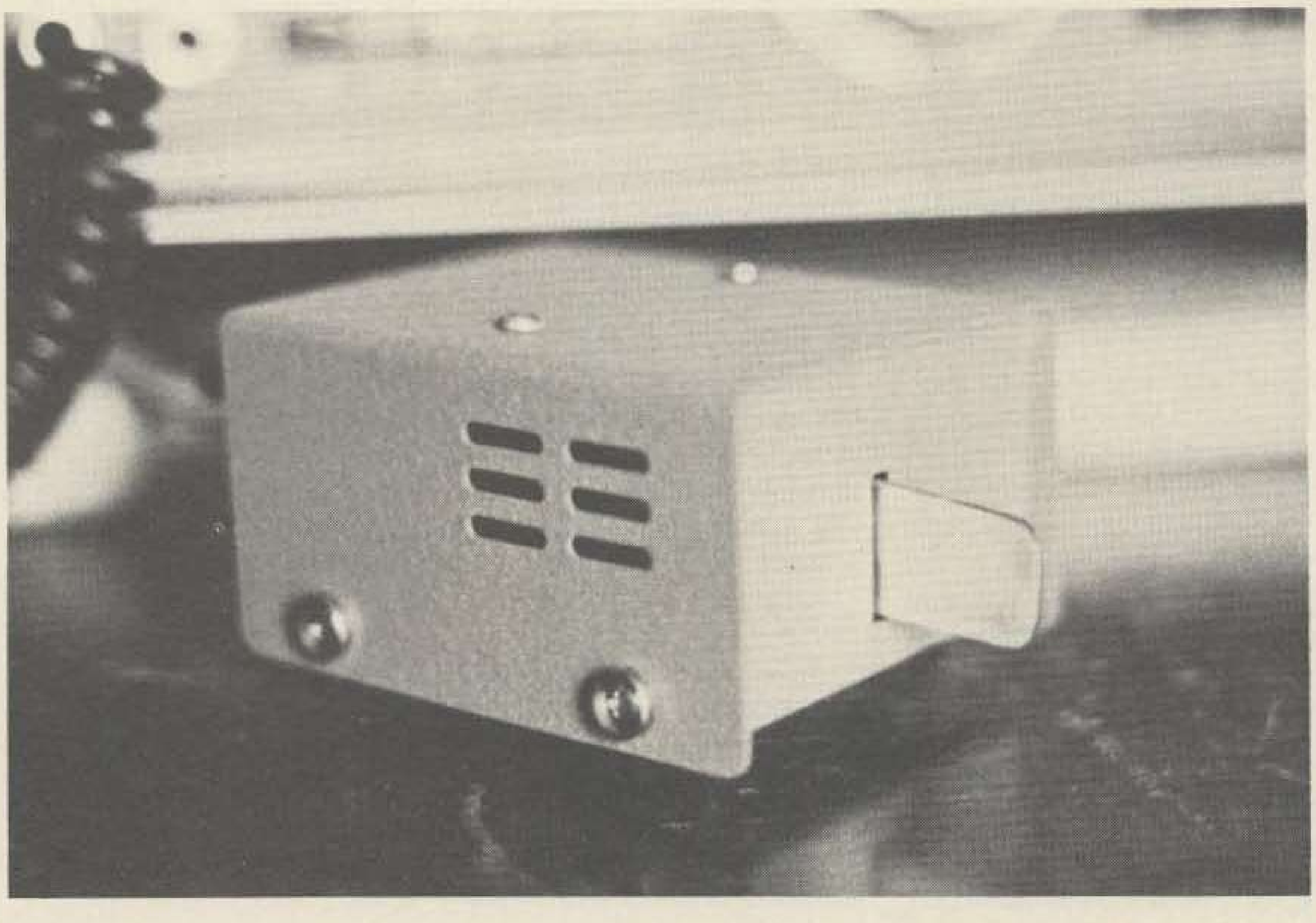
The Novice just getting into ham radio is often overwhelmed by the amount of equipment that is available and the high price for that equipment. It is no longer possible for the beginner to make his own receiver unless he has a ham friend to help him. Even then, he would probably settle for the regenerative beginner's model only until he could afford or borrow a better one.

It is still possible to build your own transmitter (also with a little help from a friendly ham) as long as you are going to work CW only. But going sideband is just out of reach, unless you can get your hands on a commercial rig.

Even the experienced ham today usually depends on commercial or kit receivers and transmitters, except for CW, and does his building and experimenting with other ham gear, gadgets to improve the shack or make operating more convenient, etc. Among these extra items, and one that the Novice might easily dream of graduating to, is a bug, or, even more high class, an electronic keyer.

The one described here is a good electronic keyer, one a Novice can build and get working, and even one that he can afford. The only parts you will have to buy (providing you have dismantled a few TV sets or have a supply of resistors, capacitors, wire, etc.) will be the four cheap ICs (integrated circuits), sockets for same, and a piece of perforated board (which could be made at home, if necessary). Add to these a half-dozen transistors and a couple FETs (field effect transistors), if you want the deluxe version, and you can probably buy all the parts for less than the price of a good hand key, which will cost up to $8.00.



I call it a deluxe keyer because it has touch control — which even your ham friends probably don't have unless they spent a lot of money on their keyers or are pretty good ham experimenters. Although you should have no trouble making a regular paddle (much, much cheaper than buying one), it is even easier to make the solidly-mounted paddle for the deluxe version, as it needs no pivots or contact points – no moving parts at all. All you have to move are your finger and thumb to work this keyer. There's no paddle to push or squeeze – just a touch will do it.

The Novice, of course, has learned code at the rate of five words a minute. But it is often pretty sloppy code (witness the Novice on the air). With this electronic keyer that you can build yourself, you can learn quickly to send perfect code and take pride in that accomplishment. Anyone who has some knowledge of soldering (with a soldering pencil) and an ability to read and follow diagrams can build this keyer. It requires no printed circuit board, and all the parts can be bought very economically by mail from ads in *73 Magazine* or from your local Radio Shack.

A good feature of an electronic keyer like this is that you can set the speed of the characters at about thirteen words per minute and still send as slowly as you wish by your spacing between letters and words. This is recognized as a better way to learn the code than learning it by sending slow dits and slower dahs. Sending each character at a thirteen word-per-minute rate and slowing down only the spaces prepares you for increasing your code speed without the learning plateaus that will slow up progress to your higher class license.

There is a special feature to this keyer: It uses ordinary transistor logic, TTL, which is cheap and readily available by mail. I could have used CMOS chips and the keyer would use less current. But one big disadvantage of CMOS chips is that they are very sensitive and can easily be burned out just by handling! After zapping a few of them myself, I decided that that was just not the way to go.

Also, because the newcomer (and a lot of us oldtimers too!) isn't into making printed circuit boards, I used point-to-point wiring. It might seem more time-consuming (unless you count the time making the printed board), but the equipment works just as well once it is finished. It also provides for the possibility of changing wiring, changing parts for bigger or smaller parts, etc., which you can't very well do with a printed circuit. Sockets for the ICs are, however, recommended. This makes it much easier to change chips in case one or the other gate in one IC is bad. They don't go bad often, but they are cheap, so it's better to be on the safe side.

The whole keyer can be made quite small, smaller than some of the kits on the market. I put mine in a 3 x 4 x 2 inch cabinet. If you want to include the power supply, you might want it a bit larger, however. If you make a wooden cabinet, it would be a good idea to make it in such a way that you can add some shielding (ordinary window screening) in case the rf from you rig affects the keyer. Use shielded leads from the keyer to the transmitter for the same reason, if you can find any. I had no shielding problems with my SB-104 transceiver, but you have to remember that, with the touch paddle feature, this keyer is more sensitive than other keyers. You have to be careful about what you touch – even the power leads have to be left "untouched." Touch the paddle only.

Building the keyer is made quite simple by the fact that all the parts can be anything close to the value given. There is a good 50% tolerance allowable, and the keyer will still work. So, if you don't happen to have the value that is called for on the diagram, just try something that is as

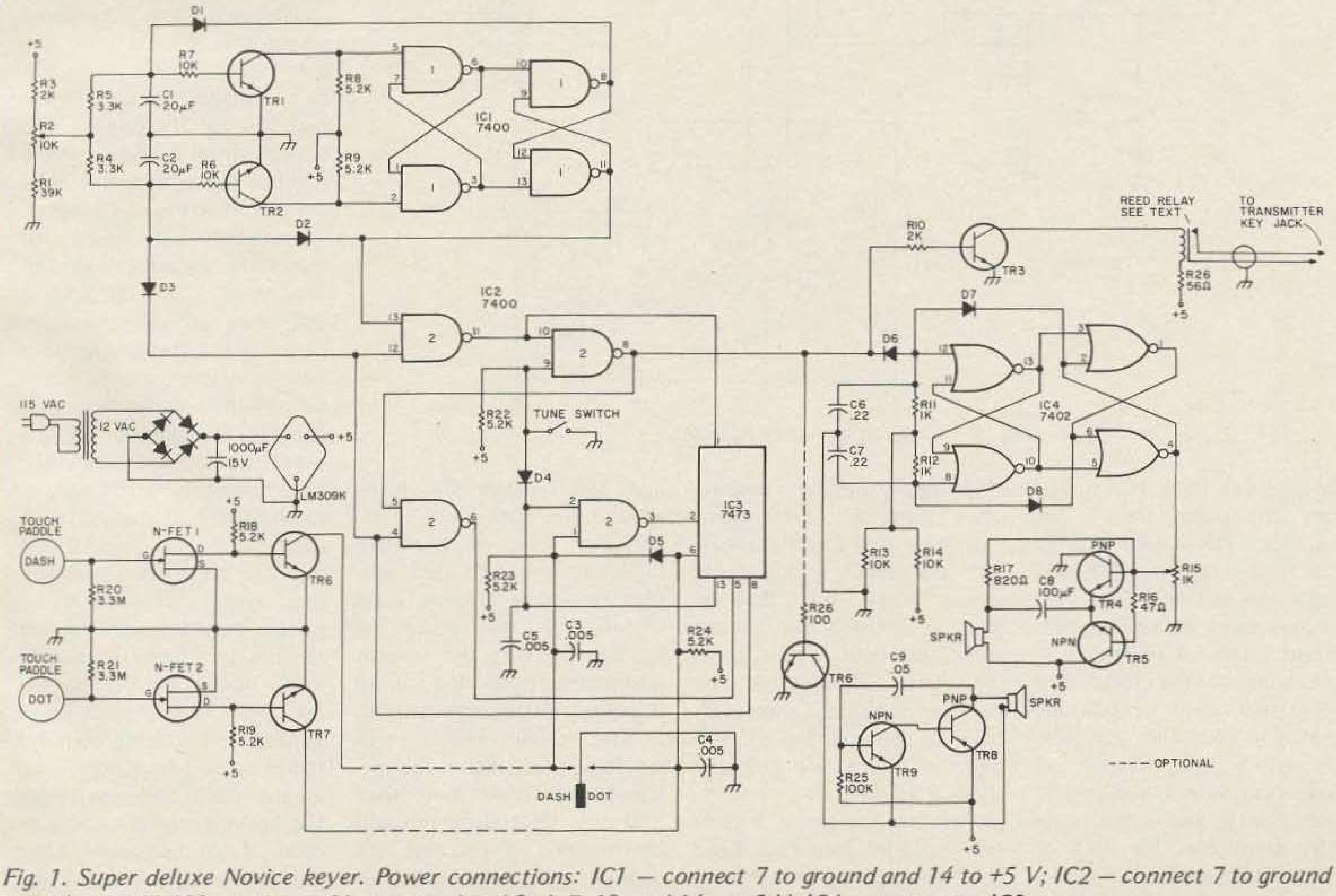


Fig. 1. Super deluxe Novice keyer. Power connections: IC1 – connect 7 to ground and 14 to +5 V; IC2 – connect 7 to ground and 14 to +5 V; IC3 – connect 11 to ground and 3, 4, 7, 10, and 14 to +5 V; IC4 – connect as IC2.

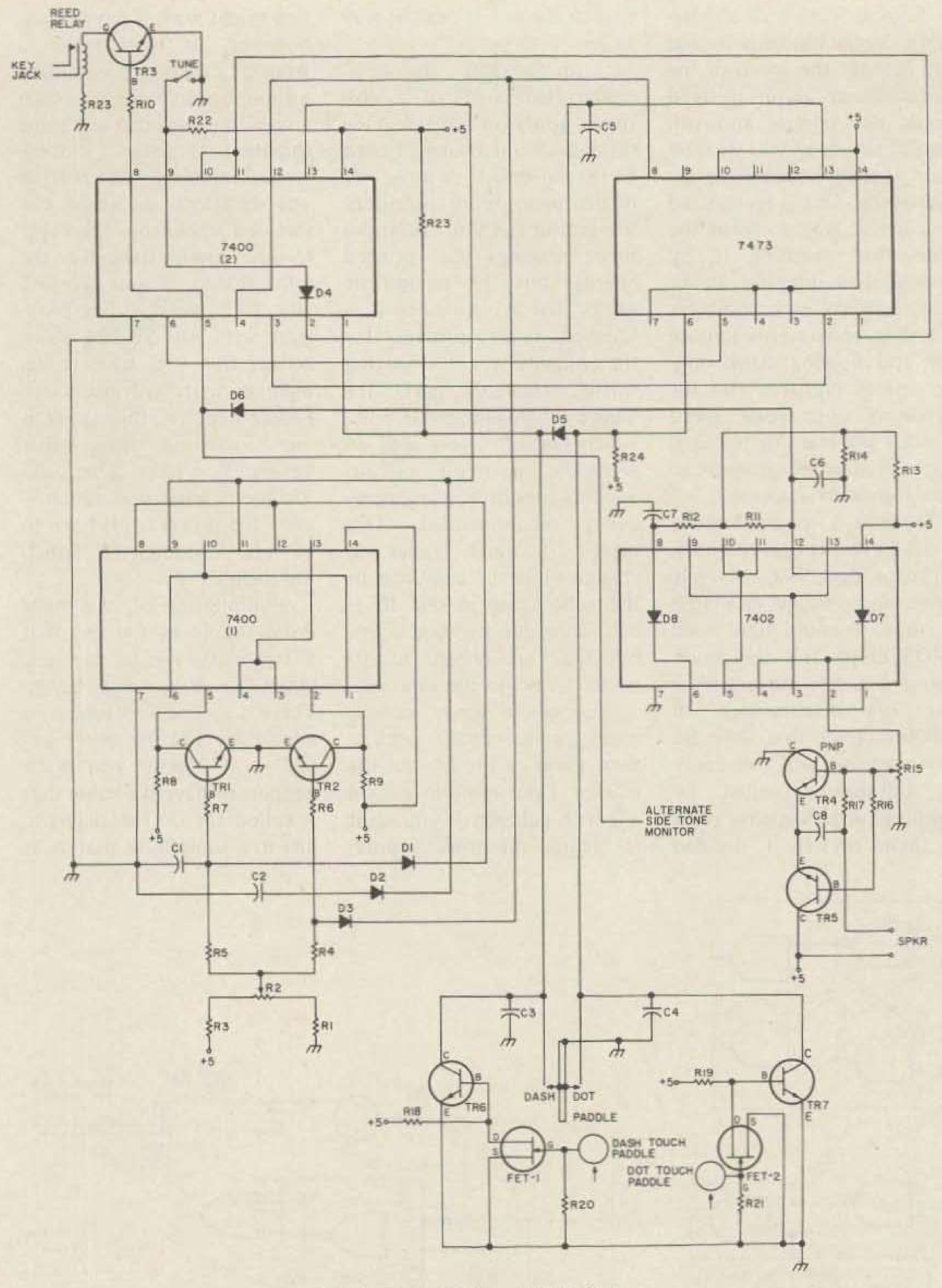


Fig. 2. Deluxe keyer wiring layout.

close as you have. It is fun to vary the parts, too – for instance, you could change the timing resistor (R2) and capacitors (C1 and C2) to get various rates of keying. Different values of resistance in the tone control (R13 and R14) also can give you a tone that you like. Use any NPN transistors you happen to have (gain is not particularly important) and, also, any PNP transistors for TR4 or TR8. This goes for the diodes used, too. I got mine by stripping computer boards. They were all FD10 types (whatever that might mean!), but any small signal diode should work well. Just be sure you install the diodes with the right polarity, as indicated on the diagram. The rectifier diodes, however, have to be capable of 500 mA, so don't use ordinary signal diodes here.

The reed relay is a mini relay sold by Poly Paks. Find the thinnest magnet wire you have around, say #34 or so, and wind about 800 turns around the glass-enclosed relay. For R26, try a couple different resistors, until you find one that gives a good closure of the relay on keying. Or skip the resistor altogether, if you don't mind drawing a little extra current.

The whole keyer, with sidetone at high volume, should not draw more than 250 mA. Of course, this will be lessened if you use the optional sidetone monitor shown on the diagram. And, of course, you will draw even less current if you skip the sidetone feature altogether and depend on an rf keying monitor on your rig for monitoring. The keyer, as good as it is, is still just a simple three-IC keyer, so it can be reduced to these first three ICs, if you wish the basic keyer alone.

The sidetone monitor, as given, is coupled directly to the last IC in the keyer itself (IC2), so the tone might change with a change of volume. If this is undesirable, you could add another IC and use two or three gates as buffers, or, preferably, find a transistor output transformer and skip the OTL (output-transformer-less) circuit used. I used it to increase the volume, as I didn't happen to have an output transformer available at the time. I've included another sidetone circuit which skips the last IC altogether – you'll have to experiment, however, to get the volume you want.

The paddle is homemade, constructed from a piece of plastic that is fairly stiff. Cut two pieces of thin aluminum to the shapes shown, one for each side of the paddle, and glue them on each side of the paddle. Note that the bolts are offset from each other. These bolts are used for mounting – using any kind of bracket you can think of – and they are also used as contacts for the paddle. One bolt contacts one piece of aluminum, and the other bolt contacts the aluminum on the other side. Then from the bolts come the leads that go to the gates of the FETs on each side of the paddle. If you don't use the touch feature, you can fabricate a paddle out of a piece of stiff aluminum or iron (like a table knife blade) by bolting the far end onto the keyer ground and putting contacts (small bolts through brackets) at the front end just inside the keyer enclosure, close to each side of the paddle. After a little use, you will find that you want the contacts very close to the paddle so that you barely have to move the paddle between dots and dashes.

I power my keyer from my SB-104 transceiver 5-volt supply, but I've included the diagram of a simple power supply consisting of a twelve-volt transformer, rectifier bridge, capacitor, and an LM309K voltage regulator. This last insures you will get only five volts on the keyer. The ICs are not very tolerant of much higher voltages. Don't try to use a six-volt transformer, as you will have to use much more capacitance, and the keying will be erratic.

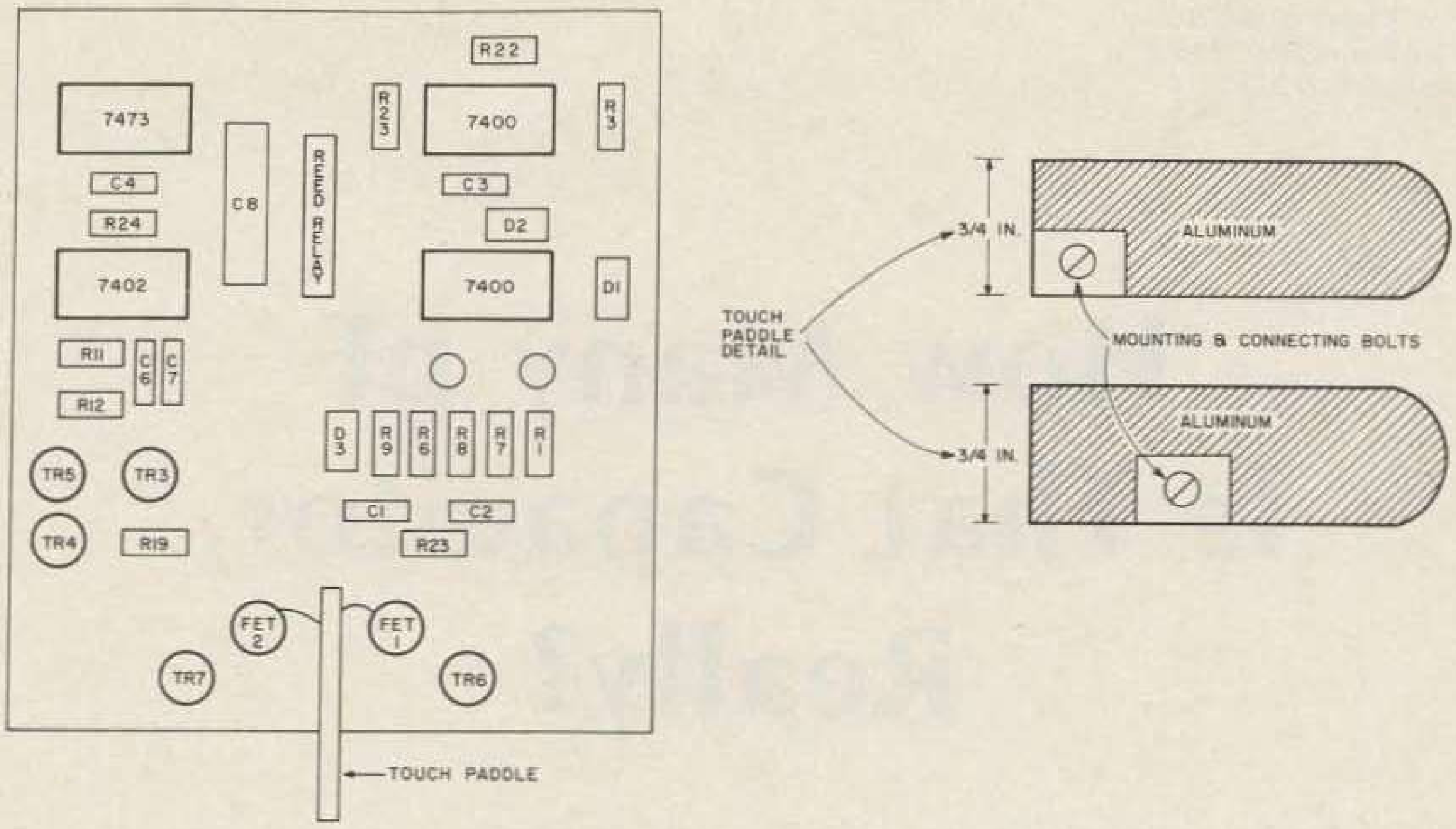


Fig. 3. Deluxe keyer parts layout.

The complete diagram of the keyer is given in Fig. 1. Fig. 2 is perhaps even more important, as it gives you the actual wiring layout to wire the parts on the board. A parts placement I used for the top of the board is given, but placement is mostly up to you. What is not indicated above chassis (board) is put in somewhere below. Don't crowd the parts. Bring out wires from the IC sockets and place the parts well away. Parts placement is not at all critical, and leaving plenty of room will make it easier to check voltages, etc., for debugging.

After wiring comes the debugging. If you go about this in a systematic way, you will have no trouble. Of course, if the keyer works as soon as you put it together, all you have to do is put it in a cabinet, and that's it. But it's possible there will be some part wired wrongly or forgotten.

First check out your input wiring. Is it really 5 volts or close to it? Then check that all the ICs are actually getting this 5 volts on all the pins listed for 5 volts. If some IC doesn't have five volts where it should, trace down your wiring till you find where the five volts disappear – it may be a capacitor that is shorted, or it may be that you forgot to wire that particular pin on the IC. After making sure of the power to all ICs, check voltages, as given in the debugging chart, for the rest of the pins with the power connected but, at first, without touching the paddle. See if the pins are high (close to 5 volts, that is, anywhere between 3.5 V to 4.5 V) or low (less than 2 V). If these are not as the chart indicates, again check the IC itself (by substituting another one, if you have one, or by begging one off some ham friend), perhaps by having a ham friend who has worked with ICs check it out for you.

If you have to check out the ICs yourself, there have been a number of good articles on ICs in *73 Magazine* that you would do well to study. Once you know about gates and flip-flops, it isn't hard to make simple checks to see if they are working or not. Remember that the IC has to have its five volts and ground connected before you can get a gate to work like it should.

Once the static condition of the keyer is checked out, you connect the paddle to ground or touch the touch paddle and check again according to the chart. On several pins, the voltages will fluctuate between zero and your full high voltage (close to five volts). However, your meter will be unable to indicate this at the keying speed. It will wobble around some intermediate voltage. This is what I mean by voltage varying with keying speed. Some pins, however, will change abruptly from high to low and vice versa, and, of course, the power connections will remain high.

The whole keyer is actually a lot simpler than the diagram indicates. I put together a demonstation model on a protoboard first, and it worked right off, even though it looked a big mess. If you leave yourself plenty of room to check it out, it will go together in a surprisingly short time. And it will make your keying sound very good once you practice a little and get to know how an electronic keyer works. Here's hoping I'll hear a lot of good CW on the bands very soon. ■

First: Check all pins that should be connected to +5 volts to see if the 5 volts are reaching these pins.

With power applied but key not contacting, check for the following:

IC1 – High (near 5 volts): pins 1, 2, 5, 6, 9, 10, and 11.
Low (near zero): pins 3, 4, 8, 12, and 13.
IC2 – High (near 5 volts): pins 1, 5, 6 (grounded when dot is sent), 9, and 13.
Low (near zero): pins 2, 8, and 12.

Power applied and either dot or dash paddle grounded:

IC1 – Pins 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, and 13 vary at an intermediate voltage while keying, depending on keying speed.
IC2 – Pin 1 goes low on dash.
Pins 4 and 12 go high and remain thus while keying.
Pins 5, 6, 8, 10, 11, and 13 vary at an intermediate voltage while keying.
IC3 – Pins 1 and 5 vary in voltage with keying speed.
Pin 6 goes low when dot is sent.
Pin 8 goes high and remains there while keying.
Pin 9 goes low and remains there while keying.

Table 1. Debugging chart for super deluxe keyer.

Parts List

R1	39k
R2	10k pot
R3, 10	2k
R4, 5	3.3k
R6, 7, 13, 14	10k
R8, 9, 18, 19, 22, 23, 24	5.2k
R11, 12	1k
R15	1k pot
R16	47 Ohm
R17	820 Ohm
R20, 21	3.3 megohm
R25	100k
R26	56 Ohm
C1	20 uF
C2	20 uF
C3, 4, 5	.005 uF
C6, 7	.22 uF
C8	100 uF 10 V
C9	.05 uF