Building and Operating: Touch Paddle
from Jackson Harbor Press

Introduction:

General notes on building the Touch Paddle

The integrated circuit (U1) is a CMOS device. This means that it should be handled as little as possible to prevent static damage. The builder should use a grounding strap and anti-static mat if available or at the very least, work on a grounded metal surface and be sure to touch ground prior to touching the ICs.

One decision the builder should make before starting construction of the Touch Paddle kit is how the project will be mounted in the case. Ideally, the Touch Paddle should be mounted in an all metal case to minimize RF pickup - an Altoids tin will work fine. A vertical slot will have to be cut in the case to permit the contact area of the touch paddle to extend outside the case. The metal edges of the slot should be insulated to prevent shorting the traces to the contact areas to ground. The circuit board can be mounted to the case with small right angle brackets which are fastened with 4-40 sized hardware. Note that when a metal case is used, the operator should refrain from touching the case with either hand if the plastic insulating cover over the contact area is NOT used. Touching the metal case will reduce the sensitivity of the paddle in this instance.

I first built the prototype and then attached it to a block of wood - this doesn't provide any extra protection against RFI or static induced strangeness, but it is quick and easy - if shielded cable is used to connect to the transmitter, RFI pickup should be minimal.

The builder should also look at the modifications mentioned later in this doc - it may be easier to try one of these mods before the whole kit is built.

The components should be inserted a few at a time, soldered in place and then clip the leads. The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

Building the Touch Paddle

Step 1) Get the parts together: All of the board mounted components have been supplied but you will still have to provide off-board items to fully implement the kit. These items include:

Output connector, optional to keyer
metal case, an Altoids tin will work fine
OR
a block of wood to mount the paddle on
shielded cable plus connector to your keyer paddle input
mounting hardware, 4-40 sized

Step 2) Identify and orient the components: Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions. The electrolytic cap is clearly marked for polarity - be sure to orient the negative stripe correctly per the parts placement diagram. The diodes are the small blue axial components - the band indicates the cathode end of the diode.

step 3) Place and solder the components on the main circuit board: Use the parts placement diagram for information on the placement and orientation of the parts. Clip the leads after soldering. Here is a suggested sequence for inserting/soldering the parts:

a) DIP socket - should be inserted with the notch towards the contact area of the board
b) starting at the center of the board, insert the 27 pF capacitor, C4, at the left of the socket.
c) working up, insert the 22 M ohm resistor (red red blue gold), R2, above the socket and C4
d) next resistor up, insert the 10 k ohm resistor (brown black orange gold), R6, above R2
e) top resistor, insert the 10 K ohm resistor (brown black orange gold), R5, above R6
f) insert the 27 pF capacitor, C3 to the right of R5/R6
g) insert the 22 M ohm resistor (red red blue gold), R1, to the right of C3 at the top
h) working down, insert the 10 M ohm resistor (brown black blue gold), R4, below R1

I) working down, insert the 10 M ohm resistor (brown black blue gold), R3, below R4
j) working down, insert the BAT41 diode, D1, below R3, with the stripe to the left
k) working down, insert the BAT41 diode, D2, below D1, with the stripe to the left
l) at the bottom, insert the 1 uF capacitor, C1, below D2, with the minus stripe down
m) finally, insert the .1 uF capacitor, C2, to the right of C1

Step 4) Check the board: Before proceeding, take the time to check the bottom of the board for solder bridges. Use the bottom view diagram as a guide to visually check for these shorts. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass to see these problems. Also, double check the orientation of the critical components such as the 1 uf electrolytic cap and the diodes. After you are convinced that the board is OK, form the leads of IC U1 to fit in the socket, insert the IC the socket, being sure to follow the parts placement diagram for proper orientation (pin 1 indicated by a notch or dimple should be towards the contact area of the board.

Next, connect the board to your keyer via the holes on the end, L is the left side paddle, R is the right side paddle and G is the ground connection.

Try it out, pressing the contact area on either side of the board should result in dits and dahs being sent.

Operation: The Touch Paddle requires no adjustments or batteries. The circuit is powered from the keyer pullup resistors. The circuit is imperfect - especially in dry weather. The touch paddle relies on skin resistance to actuate the paddle. Adding a little moisture to your fingertips will help the paddle operation, but

DO NOT go to your mouth for this moisture !

The circuit board is solder plated, you don't want to be accidentally adding any Lead to your diet. Also,

Be sure to WASH YOUR HANDS after any use of the paddle.

Lead is a nasty material , please heed these warnings, especially for kids !!

For the above reasons, a small cover is included with your kit which should be slipped over the interleaved contact area of the paddle. This cover has a sandwich of conductive and insulating plastic which forms a touch sensitive switch.

Circuit description:

The circuit is powered from the dit and dah outputs, the keyer will "pull up" these connections using a medium value of resistance. The two diodes of this circuit route this pullup voltage to the power supply pin of the IC and charge the capacitors. The diodes are silicon Schottky construction to minimize the voltage drop across them. When either or both the dit/dah connections are taken low, the diodes isolate the IC power pin. The circuit uses very little current, so the voltage across the capacitors will be retained even if both paddles are held for several seconds. This ingenious idea was revealed in a QRP Quarterly article by Ingo Meyer, DK3RED. In fact, the touch paddle circuit is the result of trying Ingo's design for a paddle using a force sensor - I happened to notice that the circuit worked better by just touching the input resistors directly as it did by pressing the rather expensive force sensors.

The paddles work when something conductive bridges the interleaved fingers of the contact areas of the circuit board. Even a large resistance will bring the input of the IC above the switching threshold. Since the other input of the NAND gate is already high, the output of the gate will go low. The outputs of the CD40107 gate are open drain which is perfect for this application since there is no contention between the gate output and the pullup resistance when both are high. The 22 and 10 megohm resistors form a roughly 1/3 supply voltage divider to increase the sensitivity of the paddles slightly. The 10 k ohm resistor and the bypass capacitor help protect the gate input by dissipating large static currents from the fingers and RFI from the transmitted signal.

Modification ideas:

1) The touch paddle when used with the supplied plastic cover can actually function without any of the other circuitry. Disconnect the left side of R2 and reconnect that left node with a wire jumper to ground. Then disconnect the left sides of R5 and R6. These nodes can then be connected to the keyer paddle inputs.

2) This kit was born out of an attempt to use a force sensor (a touch sensitive variable resistor) per an article by Ingo Meyer in the January issue of QRP Quarterly. The force sensors are now available in the US at Digi-Key, they are from the vendor Stack. One part number that I've used is Digi-Key number 102-1213-ND. This sensor can be used to replace the R1 and R2 resistors. When the force sensor is pressed, the paddle outputs will be actuated. There are two problems with the force sensors, they are fairly expensive and they seem to require a fairly hard touch to function in this circuit.

3) The plastic cover used to protest the operator's fingers from the lead on the interleaved contacts uses conductive plastic as the bridging element of the switch - possibly other materials may work better in this application such as aluminum foil or some other thin metals.

4) If RFI problems are encountered with the paddle, some experimentation may be required with the series resistors, R5 and R6 OR with the small bypass caps, C3 and C4. Increasing their values may minimize the effects of incidental RF on the paddle contacts.

5) Although it shouldn't be required, the power for the circuitry can be gotten from a battery. U1 is a 4000 series CMOS logic device which will operate over a wide range of voltages from 3 to over 15 Volts. The power and ground connections can be made across the filter caps C1 and C2 - be sure to connect with the correct polarity. The diodes will block voltages higher than the keyer supply voltage.

6) For those who prefer wider spacing on their paddles, a couple of ideas might be tried. First, self-adhesive rubber feet (3M Bumpons) can be affixed to both sides of the plastic cover to thicken the paddle. Second, the plastic cover can be removed and replaced with the anti-static black foam (used for transporting Integrated Circuits without damage). The foam can be covered with tape, which will also hold it to the paddle. An insulating spacer between the foam and the paddle contact area may be required, use two squares of some clear plastic bag with some holes punched in it. I've found that the contact pressure using the black foam is too high for my convenience.

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:

jacksonharbor@att.net

Thanks for choosing the Touch Paddle kit and
Best Regards,

Chuck Olson, WB9KZY

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List of parts included with the Touch Paddle kit

Ref	marking	Description
C1	1 uF 50V	1 uf electrolytic capacitor
C2	.1M or 104	.1 uf multilayer ceramic .1" lead space cap
C3	27J	27 pF disc ceramic capacitor
C4	27J	27 pF disc ceramic capacitor
R1	22 megohms	red red blue-gold 1/4 watt resistor
R2	22 megohms	red red blue-gold 1/4 watt resistor
R3	10 megohms	brown black blue-gold 1/4 watt resistor
R4	10 megohms	brown black blue-gold 1/4 watt resistor
R5	10 k ohms	brown black orange-gold 1/4 watt resistor
R6	10 k ohms	brown black orange-gold 1/4 watt resistor
U1	CD40107	8 pin DIP, dual NAND gate with open drain outputs
		8 pin machined pin socket (for U1)
		circuit board

Items you'll need to provide to complete the Touch Paddle kit

Metal case (an Altoids tin is fine)

OR

a block of wood for mounting the paddle

bracket and other 4-40 sized mounting hardware

output jack, stereo

shielded cable plus connector for your keyer

solder