Building and Operating: Touch Switch II
from Jackson Harbor Press

Introduction:

The Touch Switch II is a follow on kit to the Touch Paddle kit. It is based on a design by John Simonton of PAIA Electronics. The Touch Switch II uses a capacitive sensing circuit which allows better performance than the Touch Paddle (no conductivity problems) and also prevents the need for the user to touch any metal directly. The downsides of the Touch Switch II include much higher power consumption than the Touch Paddle and the potential for RFI due to the nominal 50 kHz square wave clock.

A few minor changes and additions were made to the original circuit: Two MOSFET transistors were added to invert the output. An RC circuit is used to stop the clock of the Touch Switch after a few minutes to reduce the power consumption. The delay kicks in after the last time either switch has been touched. Once the Touch Switch goes "to sleep" it must be awakened with a press of a momentary contact switch. This circuit can be bypassed by tying the switch input high if the Touch Switch is operated from a power supply rather than a battery.

General notes on building the Touch Switch II kit

The integrated circuits (U1 and U2) and the three transistors (Q1-Q3) are MOS devices. This means that they 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 these devices.

One decision the builder should make before starting construction of the Touch Switch II kit is how the project will be mounted in the case. Ideally, the Touch Switch II 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 two touch pads for the Touch Switch II to extend outside the case. The touch pads can be mounted to the case with small right angle brackets OR a small block of wood can be used. My touch pads are two pieces of single sided circuit board roughly 3/4 by 2 inches, bare of copper except for a 3/4 x 3/4 inch area on the ends. The two pieces of circuit board are separated by a couple of bare pieces of circuit board.

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 Switch II

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 (to keyer)
metal case, an Altoids or other candy tin will work fine
a block of wood to mount the touch pads on
OR
right angle brackets to mount the touch pads on
shielded cable plus connector to your keyer paddle input
mounting hardware, 4-40 sized
touch pads, single sided circuit board material is fine

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 glass axial components - the band indicates the cathode end of the diode. The leads for the diodes should be formed as shown on the parts placement diagram with the lead at the cathode (banded) end bent around, this will insure the correct polarity if the diodes are placed per the diagram.

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. I would recommend that the builder insert parts by their profile (or height) above the circuit board starting with the lowest and working up.

a) DIP sockets - should be inserted with the notch towards the left side of the board

b) C6 and C7, small blue caps marked 104 - placed near the notch of the 14 pin sockets

c) C2, C3 and C4, medium dark red caps marked 472, placed on either side of U2

d) C1, medium dark red cap marked 102, placed next to U1

e) diodes D1 to D8 placed at various positions on the board, be sure to form the leads as shown to insure the correct polarity

f) R8, 22 meg-ohms (red red blue gold), on the left edge of the board near U1

g) R1, 10k ohms (brown black orange gold) between C1 and U1

h) R2, R4 to R7, 820 k ohms (gray red yellow gold), form the leads similar to the diodes and then place as shown.

i) R9, 820 k ohms (gray red yellow gold), place and solder on the BOTTOM side of the circuit board from pins 1 to 14 of U1

j) C5, 10 uF, place on left edge of board with negative stripe towards the left (if the leads are left long C5 can be bent at a right angle to lower the profile of the Touch Switch II slightly.

k) Q1 and Q2, 2n7000 transistors on the right edge of the circuit board, with the flat side to the right

l) Q3, 2n7000 transistor, on the lower left corner, be sure to leave the leads of Q3 a little long to allow it to be bent slightly away from U1 if needed.

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 10 uf electrolytic cap and the diodes.. After you are convinced that the board is OK, form the leads of ICs U1 and U2 to fit in their sockets, insert the ICs in the sockets, being sure to follow the parts placement diagram for proper orientation (pin 1 indicated by a notch or dimple should be towards the left edge of the board.

Next, connect the board to a 9V battery using a VOM to measure the current used, current should be less than 2 mA, if it's larger, power down and re-check the board for shorts and polarity problems.

If the current is relatively low, power down, connect the output jack, the touch pads and the momentary switch and place the board into the case.

Operation: The Touch Switch II requires no adjustments. Try it out, the Touch Switch II should function with the touch pads bare or insulated with a layer of tape or plastic.

Circuit description: An excellent explanation of the circuit is available on the PAIA web site:

http://www.paia.com/touchsw.htm

The Touch Switch II kit adds two MOSFET transistors on the outputs (Q1 and Q2, both 2n7000) to invert the positive going switch signal to a "closure to ground". The Touch Switch II also controls pin 1 of U1 using a 2n7000 (Q3) buffered RC circuit. When the transistor is ON, pin 1 of U1 is grounded which allows the gate to act as an inverter. When Q3 is off, pin 1 of U1 is pulled high by R9, which holds the output of the gate low, stopping the clock, which reduces the current used by the Touch Switch II to that disapated by R6 and R7 (20 uA or so at 9V). Q3 is driven by an RC circuit which charges the gate high when the switch is presssed and then gradually discharges through R8 until the threshold of Q3 is reached, which turns Q3 off. Two diodes, D8 and D6, are used to keep the circuit going whenever either switch is pressed.

Modification ideas:

1) If the power down feature isn't required, replace the momentary switch with a jumper to +VCC.

2) If you can hear the clock harmonics on your radio while using the Touch Switch II, consider a few changes to the circuit. Try series chokes on the outputs and the power input. I used a few turns through some ferrite balun cores. If you are using the same power supply for the Touch Switch II as for the radio, consider using a battery to power the Touch Switch II.

3) the length of operation of the Touch Switch II can be altered by changing the values of the RC pair (R8/C5). Larger values result in longer operation.

Thank you to John Simonton of PAIA Electronics for permitting me to use his touch switch circuit.

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 Switch II kit and
Best Regards,

Chuck Olson, WB9KZY

List of parts included with the Touch Switch II kit

Ref	marking	Description
C1	102	dark red, polyester capacitor, .001 uF
C2	472	dark red, polyester capacitor, .0047 uF
C3	472	dark red, polyester capacitor, .0047 uF
C4	472	dark red, polyester capacitor, .0047 uF
C5	10 uF 25 V	light blue electrolytic capacitor, 10 uF
C6	.1M or 104	.1 uf multilayer ceramic .1" lead space cap
C7	.1M or 104	.1 uf multilayer ceramic .1" lead space cap
D1	1n4148	glass switching diode
D2	1n4148	glass switching diode
D3	1n4148	glass switching diode
D4	1n4148	glass switching diode
D5	1n4148	glass switching diode
D6	1n4148	glass switching diode
D7	1n4148	glass switching diode
D8	1n4148	glass switching diode
Q1	2n7000	n channel, TO92 MOSFET
Q2	2n7000	n channel, TO92 MOSFET
Q3	2n7000	n channel, TO92 MOSFET
R1	10 k ohms	brown black orange-gold 1/4 watt resistor
R2	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
R3	33 k ohms	orange, orange, orange, gold 1/4 watt resistor
R4	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
R5	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
R6	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
R7	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
R8	22 megohms	red red blue-gold 1/4 watt resistor
R9	820 k ohms	gray, red, yellow, gold 1/4 watt resistor
U1	CD4001	14 pin DIP, quad NOR gate
U2	CD4001	14 pin DIP, quad NOR gate
		14 pin machined pin sockets (for U1 and U2)
		circuit board

Items you'll need to provide to complete the Touch Switch II kit

	Metal case (an Altoids tin is fine)
	a block of wood for mounting the switch plates
	OR
	right angle brackets for mounting the switch plates
	Misc. 4-40 sized mounting hardware
	output jack, stereo
	9V battery snap connector OR other power connector
SW1	SPST momentary switch (optional)
	shielded cable plus connector for your keyer
	two touch switch pads, single sided circuit board is fine
	solder