

# Constructing and Operating:



The PK-2  
from Jackson Harbor Press

## A PIC based keyer kit with pot speed control

### Construction:

#### **General notes about building:**

The components should be inserted a few at a time, soldered in place and then the leads are clipped. Note that all the leads for any particular pad should be inserted prior to soldering to prevent clogging the holes. The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

Also, machined pin SIP sockets (not supplied) can be used to provide the connection points to the off-board components, then the builder will be able to plug the wires from the components into the SIP sockets which simplifies moving the unit in and out of the enclosure. The builder might also consider using these sockets for the transistor and the voltage regulator. The machined pin sockets are available in snappable strips from most of the mail order surplus electronics parts suppliers.

Finally, the integrated circuit (IC) and the keying transistor are both 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 the ICs.

#### **Step 1: Get the parts together**

All of the board mounted components have been supplied. You will still have to provide off-board items from the stocklist to fully implement the keyer including the enclosure, speed pot, switch, jacks, battery holder and connector, piezo transducer and mounting hardware. Be sure to get the piezo transducer that requires external drive - basically a very high impedance speaker.

#### **Step 2: Identify and orient the components**

Most of the components should be fairly easy to identify and place except for the ceramic bypass caps. The .1 uF and .01 uF monolithic ceramic bypass capacitors are both very small yellow or blue parts with 2 radial leads spaced .1" apart. You may need a magnifying glass to see the markings on these parts. The two .1 uF parts are marked 104 OR .1M. The four .01 uF bypass caps are marked 103. Note that C6, the pot timing capacitor, is also a .01 uF capacitor but that it is reddish brown in color and has a .2" lead spacing.

#### **Step 3: Mount and solder the components on the board**

Use the parts placement diagram for the placement and orientation of the parts.

Start by inserting the 8 pin IC socket with the small notch towards the top of the circuit board and then soldering it in place.

Then insert the remaining components at the positions shown on the parts placement diagram. Three of the components should only be inserted one way or they can be damaged by reversed polarity. C2, the 47 uF electrolytic capacitor, should be inserted with the negative stripe to the left side of the board. C2 can also be inserted with the leads bent at a right angle which results in a lower overall height for the board. Q1, the 2N7000 transistor, should be inserted with the flat face to the right of the board. U2, the LM2936 voltage regulator, should be inserted with the flat face to the top of the board. Be sure to solder all the connections and clip leads.

#### **Step 4: Check your work**

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 electrolytic capacitor, transistor and voltage regulator. After you are convinced that the board is OK and after you have formed the leads of the IC to fit in the sockets, insert the keyer IC into the socket, being sure to follow the parts placement diagram for proper orientation. Now hook up the Piezo transducer (beeper) to the connection points on the left side of the board (including a connection to ground. Also solder the 9V battery snap to the top-left side of the board.

Next, power up the board. An FB should be sent by the keyer at powerup through the sidetone if the keyer is functioning correctly. Note that you will only hear the FB if the voltage across the 22 uF capacitor is fully discharged - since the keyer IC and EEPROM consume less than 10 uA of current in sleep mode it can take a long time before the capacitor is fully discharged UNLESS a switch is pressed while the power is off. If you don't hear the FB, use a VOM to measure the current drawn. With a regulator, the idle current draw after powerup at 9 V should be less than 10 uA. This will jump up to as much as 1.5 mA or so when the keyer is active.

If you see significantly higher currents, power down immediately and check again for shorts and/or opens. If the currents look reasonable, then power down and hook the unit up to the switch, pot, paddle and output jack and proceed to the Operation section.

The kit has a micropower +5V regulator which allows a user to connect a 9V battery and leave it connected without a power switch. The standby power drawn will be roughly 6 uA. Active power is about 1.5 mA maximum with both paddle switches pressed - a MOSFET is used as the output transistor and this minimizes the active current - also, the sidetone should be connected to a piezo transducer which uses only 50 uA or so.

#### **Construction Notes:**

If the keyer is to be packaged in the same case as the transceiver, it is possible to inject the sidetone directly into the audio chain of the radio instead of using a piezo transducer for the

sidetone. The circuitry needed for this injection is a fairly simple RC circuit to decrease the level of the sidetone from 5V peak to peak and also to filter the square wave slightly (see the FREQ-Mite article in the December 1998 issue of QST for more details on this type of circuit). I prefer to mount the keyer in a separate box so that it can be disconnected from the rig and used for practice nearly anywhere.

The keyer will fit into small metal boxes such as the old Sucrets boxes or the new, popular Altoids mint tins. One possible problem area for this type of enclosure is finding a pot that is small enough to fit. Mouser (800 346 6873) sells a 13 mm diameter, 100k pot (# 31CX501) that fits nicely into one of these types of tins. The small 4 mm shaft size of the pot requires a special knob - Mouser also has these (# 45KN050).

The MOSFET output transistor can be directly replaced by a 2N2222 or 2N3904 type NPN transistor. The orientation is the same, however the NPN transistor will require more drive current than the 2N7000 MOSFET.

Note that the output transistor circuit is designed to switch key inputs of 13.8 volts positive or less. Don't attempt to use the PK-2 keyer with a vacuum tube transmitter (either grid block or cathode keyed) without an appropriate outboard circuit - consult older ARRL handbooks for these circuits. For negative keying voltages consider purchasing the Grid Block Keying Adapter kit from Jackson Harbor Press.

The minimum pot speed will increase if the power supply voltage decreases below 5 volts.

### **Operation:**

General notes on using the switches to control the keyer: To give the keys multiple functions, multiple key-press combinations are used. Also, the memory switch can be pressed and released (PAR) OR pressed and held for two seconds (PAH). This also gives more combinations of the three control switches (dit, dah and memory switch).

Generally, PAR is used for actions: send the code speed or send a memory. PAH is used for settings: change the code speed (no pot) or record a memory or change the iambic mode.

4 menus are used for setting various options - they are activated by a PAH of the memory switch alone or plus a simulpress of dit or dah or both. The menu selections are made by pressing either the dit or dah levers - you will then normally hear a corresponding dit or dah via the sidetone, the selection will be made and you are then returned back to normal keyer mode. In general, the operator can skip a menu item by a PAR of the mem switch. Here is a summary of the functions of the various keypresses:

| <u>keys used</u> | <u>PAR (press and release)</u> | <u>PAH (press and hold)</u>          |
|------------------|--------------------------------|--------------------------------------|
| mem switch       | send mem 1                     | record mem 1 & beacon options        |
| mem + dit        | send speed                     | paddle set of speed and pot options  |
| mem + dah        | send CQ                        | Tune, record callsign memory & CQ    |
| options          |                                |                                      |
| mem + both       | send mem 2                     | record mem 2 & miscellaneous options |

### **Powerup:**

After powerup the keyer will send an FB through the sidetone to signal correct operation.

### **Speed Readout:**

The speed (in WPM) will be played through the sidetone if the mem switch is simulpressed with the the dit lever and then both are released. I normally press the memory switch first and hold it, press the dit lever and finally release both.

### **Speed Control and Menu:**

The speed can be adjusted by just turning the pot. Maximum speed is 39 WPM, minimum speed is 5 WPM. Note that the minimum speed can be affected by component tolerances on the timing capacitor and the speed pot - see the pot calibration menu item if a 5 WPM minimum speed is required. The pot position is read continuously when the keyer is sending code, just before each dit, dah or space is sent. This allows the operator to adjust the code speed even in the middle of a memory send or record.

If you disconnect the pot from the circuit, the keyer will powerup at a default speed of 16 WPM. The speed can be adjusted by pressing and holding the memory switch along with the dit lever. Usually I PAH the memory switch and then tap the dit lever. After 2 seconds, the keyer will send an S (for speed set). Press the memory switch to advance to the next menu item without changing the speed. Or, pressing the dit lever will increase the speed by 1 WPM and send a dit. Pressing the dah lever will decrease the speed by 1 WPM and send a dah. You can continuously adjust the speed by holding either lever but note that if you run the keyer “off the scale” at either 5 or 39 WPM, the keyer will “wrap around” to the opposite speed extreme. Exit the speed adjust routine by pressing and releasing the memory switch - the code speed will be sent via the sidetone upon exit.

### **P - Select Pot or Paddle speed control**

Normally the speed will either be controlled by the pot or via switches, but if the keyer is accidentally put into the switch mode the pot speed control can be selected by pressing dit. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to advance to the next item:

### **C - Calibrating the Pot speed control**

Due to the variation in capacitors and pots it is possible that the maximum setting of the pot will result in a minimum speed higher than 5 WPM. This menu item will compensate and store an updated calibration value in RAM. Before entering the menu, be sure to turn the pot to the minimum speed. Then press the dit to go into the calibration routine - you then may hear one or more dits and the keyer will exit from the menu. Or press the memory switch to go to the next menu item.

### **RC - Restore the default pot Calibration**

If the pot calibration is run with the pot above midscale, the keyer may jump into paddle speed control if the pot is then turned below mid-scale after calibration is complete. It won't be possible to exit paddle speed control because the calibration value is too low. This menu item will restore the default powerup calibration value in RAM and thus allow normal pot

speed control again. Press the dit to restore the original calibration value. The keyer will send a dit and then exit the menu. Or press the memory switch to exit the menu.

### **Recording the Callsign Memory or using the Menu**

A callsign of up to 10 characters long can be recorded. This can be handy for things like: WB9KZY/BCN or WB9KZY/9 . The callsign memory menu is entered by simulpressing the memory and the dah keys and holding them for 2 seconds. I usually PAH the memory switch and then tap the dah key.

### **TU - Tune mode**

After 2 seconds the keyer will send TU. Press the dit lever to enter tune mode (key down). Or press the mem switch to proceed to the next menu item. Exit tune mode by a PAR of dit or dah.

### **? - Record the Callsign Memory**

The callsign can now be recorded. When complete, press the memory switch. The record routine will be exited automatically after the 10th character is sent. Press the memory switch alone to advance to the next item:

### **CS - CQ select**

There are two different CQ sequences to select:

|                |                                    |
|----------------|------------------------------------|
| default (4x2)  | CQ CQ CQ CQ DE <call> <call> K     |
| optional (3x3) | CQ CQ CQ DE <call> <call> <call> K |

Press dit to select the 3x3 CQ or dah to select the 4x2 CQ. The keyer will send either a dit or dah and then exit the menu OR press the memory switch to proceed to the next menu item. The <call> mentioned above is the callsign memory.

### **Q - /QRP after last callsign**

This option will allow the operator to append a /QRP to the last callsign sent - for example:

CQ CQ CQ CQ DE WB9KZY WB9KZY/QRP K

Press dit to select the /QRP option, press dah to return to the default non-/QRP CQ. The keyer will send either a dit or dah and then exit the menu OR press the memory switch to exit the menu.

### **Playing the CQ + Callsign Memory**

Play the CQ memory by simulpressing and releasing the memory and the dah keys. I usually PAH the memory switch and then tap the dah lever - the memory starts to play after the memory switch is released. A tap of either the dit or dah lever will stop the message play.

### **General notes on recording Mem 1 and 2:**

Note that you can insert the callsign memory at any given point in the message by sending 6 dahs in a row. You can also insert a pause into the memory by recording the AS (di-dah-di-di-dit) character. Message play will stop when an embedded pause is reached - the paddle can then be used to send something manually - the message play can then be resumed with a

PAR of the mem key. This is useful for inserting an RST or a serial number into a message. You can also embed a space of 6 dits in length by entering a special character of di-dah-dah-dah-dit. Note that spaces do count as characters in the capacity of a memory. You can insert the callsign memory, pause or space multiple times - each insertion takes up one character in memory.

### **Playing Mem 1**

Play the memory with a PAR of the memory switch. The memory will start to play right after the memory switch is released. A tap of either the dit or dah lever will stop the message play.

### **Recording Mem 1 and Menu**

The Mem 1 menu can be entered by a PAH of the mem switch (alone) for 2 seconds. After 2 seconds the keyer will send:

#### **BE - Beacon Mode**

Beacon mode will send the contents of mem 1 continuously with a 2.5 second pause in between each play of the memory. Start the beacon by pressing the dit lever - the beacon starts to play. Exit beacon mode by tapping the dit or dah lever. Skip beacon mode by a PAR of the mem switch to proceed to the next menu item:

#### **M? - Record Mem 1**

Start sending your message - when completed, press the mem key. The memory is 52 characters long - recording will terminate automatically after the 52nd character. To skip the recording, just press the mem switch to advance to the next menu item:

#### **KD - Key Down beacon delay**

Press dit to select the key down beacon delay mode. This will enable the sending of a constant key down during the interval between sending the beacon message. Press dah to return to the default key up beacon delay. The keyer will send either a dit or dah and then exit the menu. To skip this item, just press the memory switch to advance to the next menu item:

#### **BA - Beacon Alternate between mem 1 and mem 2 mode**

To select alternating the beacon between the two memories press the dit lever. To return to the default of a mem 1 beacon only, press the dah lever switch. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to advance to the next item:

#### **D - increase the beacon delay**

Normally, the beacon delay will be about 2.5 seconds. Press the dit lever to increase the key up beacon delay to 5 seconds - the key down beacon delay will be increased to 10 seconds. Press the dah to return to the default of 2.5 seconds for both key up and key down beacon delays. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to exit from the menu.

### **Playing Mem 2**

First, hold the mem switch down, next, squeeze both paddle levers (they both must be down at the same time) then release the paddle and finally release the mem switch before 2 seconds elapse. The memory will start to play right after the mem switch release. A tap of either the dit or dah lever will stop the message play.

### **Recording Mem 2 and Menu**

The second message of up to 52 characters long can be recorded by a PAH of the mem switch and both paddle levers for 2 seconds. Hold the mem switch down, then squeeze both paddle levers simultaneously (they both must be down at the same time), then release the paddle, keep holding the mem switch until after 2 seconds the keyer will send **T?**. Mem 2 can now be recorded. When recording is complete, press the mem switch. If you wish to skip recording just press and release the mem switch alone to proceed to the next menu item:

### **PR - Practice mode**

In practice mode, the output transistor is not keyed but the sidetone is retained. Press dit to engage practice mode, press dah to return to the default of normal output keying. The keyer will then send either a dit or dah and exit the menu routine. To skip this item, just press the memory switch to advance to the next menu item:

### **B - Bug / Straight-key mode**

To enter bug/straight-key mode (dits are normal but dahs are like a straight key) press the dit lever - you will then enter bug mode. To exit bug mode press the dah lever. The keyer will then send either a dit or dah and exit the menu routine. Or press the memory switch to advance to the next item:

### **L - Live or Dead recording**

Normally, the memory or callsign will be recorded by the user off the air (dead) but sometimes it's desirable to be able to record a message on the air (live). Press the dit for live recording. Press the dah for the default dead recording. The keyer will then send either a dit or dah and exit the menu routine. Or press the memory switch to advance to the next item:

### **A - Iambic mode A or B**

The A mentioned above signifies the mode A/B select menu item. The iambic mode of the keyer can be set to either mode using this routine. Check the JHP web site for an Acrobat (.pdf) file which explains the difference between the A and B keying modes.

Press the dit lever for mode A. Press the dah lever for the default mode B. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to advance to the next menu item:

### **R - Reverse paddle mode**

To reverse the dit and dah levers, press either the dit or dah lever. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to advance to the next menu item.

### **ST - SideTone on/off**

To turn the sidetone OFF, press the dit lever. To turn the sidetone ON, press the dah lever. The keyer will send either a dit or dah and then exit the menu. Or press the memory switch to exit the menu. Note that the sidetone will still be engaged during any menu or recording entry even if it is turned off with this menu item - this item allows the user to employ his rig sidetone.

**Notes:**

C2, the 47 uF capacitor, will retain power on the keyer chip for quite a while even without the 9V battery connected. This can cause trouble if the keyer gets hung up because any scrambled RAM memory will be retained. To clear scrambled memory, remove power and then short out this capacitor. Since all the memory and control settings are contained in the RAM, all will be lost if the keyer is completely powered down.



## PK-2 Stocklist

| Qty. | Ref.        | Part Name | Description                                      |
|------|-------------|-----------|--|
| 1    | U1          | 12C672    | PK-2 8 pin DIP keyer chip - Microchip Technology |
| 1    | U2          | LM2936    | 5V ultra low standby current regulator           |
| 2    | C1,C8       | .1 uF     | .1" lead space multi-layer ceramic capacitor     |
| 4    | C3,C4,C5,C7 | .01 uF    | .1" lead space multi-layer ceramic capacitor     |
| 1    | C6          | .01 uF    | .2" lead space, 5% polyester capacitor           |
| 1    | C2          | 47 uF     | .079" lead space 25V electrolytic capacitor      |
| 1    | R2          | 6.8 K ohm | Blue-gray-red - 1/4 watt metal film resistor     |
| 1    | R3          | 1 K ohm   | Brown-black-red - 1/4 watt metal film resistor   |
| 1    | R4          | 180 ohm   | Brown-gray-brown - 1/4 watt metal film resistor  |
| 1    | Q1          | 2N7000    | TO-92 package MOSFET transistor                  |
| 1    | -           | socket    | 8 pin DIP socket                                 |
| 1    | -           | PCB       | PIC Keyer circuit board                          |

The following items are **NOT** included with the kit:

|   |       |           |  |
|---|-------|-----------|--|
| 1 | R1    | 100 K ohm | Linear potentiometer                             |
| 1 |       |           | knob for pot R1                                  |
| 1 |       |           | Piezo transducer Digi-key P9924-ND or equivalent |
| 1 | J1,J2 |           | stereo paddle jack                               |
| 1 |       |           | xmtr jack  |
| 1 |       |           | 9 volt battery "snap" connector                  |
| 1 | SW1   |           | normally open, momentary SPST switch             |

Copyright © 1998 by Charles J. Olson,

Jackson Harbor Press

RR1, Box 91C

Washington Island, WI 54246

jacksonharbor@worldnet.att.net

<http://home.att.net/~jacksonharbor>