

The NorCal Keyer **An Inexpensive Keyer with Pot Speed Control**

Note: The NorCal QRP Club web site has a complete article on how to build the NorCal Keyer by Jim Kortge, K8IQY. If you are a new builder, I would suggest that you look at it. <http://www.norcalqrp.org/nckeyerelmer.htm>

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, the builder will then 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 transistors and the voltage regulator. The machined pin sockets are available in snappable strips from most of the mail order surplus electronics parts suppliers.

The NorCal Keyer is a CMOS (Complimentary Metal Oxide Semiconductor) device. This oxide is very thin which means that the chip should be handled as little as possible to prevent static damage. The installer 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 chip.

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 stock list to fully implement the keyer including the enclosure, jacks, speed pot, battery holder and connector, and mounting hardware.

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 .01 uf monolithic ceramic bypass capacitors are very small blue parts with 2 radial leads spaced .2" apart. You may need a magnifying glass to see the markings on these parts. The four .01 uf bypass caps are marked 103. Note that C4, the pot timing capacitor, is also a .01 uf capacitor but that it is reddish brown in color and has a .2" lead spacing. You must use the brown cap for C4.

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

Use the parts placement diagram for the placement and orientation of the parts. Then insert the components at the positions shown on the parts placement diagram. Make sure that you watch the orientation of C6, the tantalum capacitor. The positive lead, marked with a +, must go in the hole nearest to U2, the 5V Voltage regulator. Also, note that the silk-screening on the board is for the old style capacitor used in the 1st version of this kit. Q1, the NPN transistor, should be inserted as per the silkscreen on the board. Be sure to solder all the connections and clip the leads.

Step 4: Check your work:

Before proceeding, take the time to check the bottom of the board for solder bridges. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass too see these problems. Also, double check the orientation of the critical components such as the transistor, voltage regulator, U2, and the tantalum capacitor C6. 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 battery holder leads 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. If you don't hear the FB, use a VOM to measure the current drawn. During standby (sleep mode) the keyer will use roughly 1 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.

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 Tick article in the October 1997 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).

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 NorCal Keyer keyer with a vacuum tube transmitter (either grid block or cathode keyed) without an appropriate outboard circuit - consult older ARRL handbooks for these circuits.

The minimum pot speed will increase as the power supply voltage decreases due to the shift in input threshold voltage of the NorCal Keyer keyer chip.

Operation:

General notes on using the dit, dah and mem switch to control the keyer: The switch on pin 4 of the keyer chip will be referred to as the mem switch. Multiple functions result from multiple switch-press combinations (mem alone, mem+dit, mem+dah, mem+both dit and dah). Also, the switches can be pressed and released (PAR) OR pressed and held for two seconds (PAH). This doubles the number of combinations of the three control switches.

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 mem switch alone or plus a simulpress of dit or dah or both. The menu selections are made by pressing either the dit or dah switches - 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.

Note that the keyer sidetone will be lower in pitch (about 360 Hz) for keyer commands such as the menu prompts, recording a memory or the FB sent at powerup. The normal pitch for routine sending is higher at about 720 Hz

A Function Table of the Keypress Combinations

keys used	PAR (press and release)	PAH (press and hold)
mem switch	send memory 3	record memory 3, O?, also beacon items: BE and BA
mem + dit	send speed	paddle set of speed, pot options, main menu
mem + dah	send memory 2	record memory 2: M?
mem + both	send memory 1	record memory 1: T?

Powerup:

Immediately after powerup the keyer will send an FB through the sidetone to signal correct operation, EXCEPT if either the dit or dah input was pressed during powerup. Then the RMK will enter a compatibility mode with the original part. The paddle opposite to the one pressed at powerup will act as a straight key. The only function of the mem switch will be to toggle the offset frequency. Note that the switch must be pressed each time the transceiver is powered up to enter compatibility mode - it is NOT stored in EEPROM as the other mode changes are.

Speed Readout:

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

Speed Control and Menu:

Initially the keyer will powerup at a default speed of 16 WPM in paddle speed set mode. The speed can be adjusted by pressing and holding the mem switch along with the dit switch. Usually I press and hold {PAH} the mem switch and then tap the dit switch. After 2 seconds, the keyer will send an S (for speed set). Press the mem switch to advance to the next menu item without changing the speed. Or, pressing the dit switch will increase the speed by 1 WPM and send a dit. Pressing the dah switch will decrease the speed by 1 WPM and send a dah. You can continuously adjust the speed by holding either switch but note that if you run the keyer "off the scale" at either 4 or 50 WPM, the keyer will "wrap around" to the opposite speed extreme. Exit the speed adjust routine by pressing and releasing the mem switch.

If the pot circuitry is connected AND the P menu is invoked to turn on the pot speed control the speed can be adjusted by turning the pot. Maximum possible speed is 48 WPM, minimum possible speed is 4 WPM. Note that the minimum and maximum speed can be affected by component tolerances on the speed pot and the resistors - see the pot calibration menu item if a 4 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

Mem + dit menu (PAR mem to advance to the next menu item)

	Menu item	pressing a dit:	pressing a dah:
S	Speed set from paddle	increases speed by 1 WPM	decreases speed by 1 WPM
P	Pot / paddle speed control	selects pot speed control	selects paddle speed control
C	Calibrate pot speed control	enters the calibration routine	restores default pot calibration
B	Bug / straight key mode	enables bug mode (dah = key)	disables bug mode (default)
A	iambic mode A or B	enables iambic mode A	enables mode B (default)
R	Reverse paddle mode	reverse dit and dah switches	return dit and dah to normal
AU	Autospace on / off	turns on character autospace	turns off autospace (default)

P - Select Pot or Paddle speed control:

Allows the keyer to be switched between pot or paddle speed control. The keyer defaults to paddle speed control.

C - Calibrating the Pot speed control:

Due to the variation in resistors and pots it is likely that the minimum setting of the pot will result in a minimum speed higher than 4 WPM. This menu item will compensate and store an updated calibration value. Before entering the menu, be sure to turn the pot to the minimum speed. Then press the dit to go into the calibration routine - then one dit will be sent after a short delay and the keyer will exit from the menu. If the pot calibration is run with the pot not set at the minimum, rerun the cal with the pot correctly set. Pressing a Dah will restore the default powerup calibration value.

B - Bug / Straight-key mode:

Dits are sent normally but dahs are sent like a straight key.

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.

R - Reverse paddle mode:

Reverses the dit and dah switches (easier than resoldering a jack). Remember that the pot speed control will be changed to the dit paddle which means that pot speed control changes while the dit is pressed will be ignored until the dit is released.

AU - Autospace on/off:

The autospace feature inserts a character space (1 dah in length) automatically if the operator has not pressed a paddle switch 1 dit space after the last dit/dah sent. This feature is always on in the memory record routines (needed for the recording process).

Recording Memory 2:

A memory of up to 40 characters long can be recorded. The memory 2 record menu is entered by simulpressing the memory and the dah keys and holding them for 2 seconds. I usually PAH the mem switch and then tap the dah key.

Mem + dah menu (PAR mem to exit)

	Menu item	Pressing a dit:	Pressing a Dah
M?	Record memory	records a dit	records a dah

M? - Record Memory 2:

The memory is recorded by sending normally. Note that the keyer output is off during the recording and that the lower command sidetone is used. When complete, PAR the mem switch. The routine will be exited automatically after the 40th character is sent. The memory is saved in flash memory which means that it will still be there even if power is removed. If this menu item is entered by mistake, PAR the mem switch to exit without changing the memory.

Playing Memory 2:

Play memory 2 by simulpressing and releasing the memory and the dah keys. I usually PAH the mem switch and then tap the dah switch - the memory starts to play after the mem switch is released. A tap of either the dit or dah switch will stop the message play.

Mem switch menu (PAR mem to advance to the next menu item)

	Menu item	pressing a dit:	pressing a dah:
O?	Record memory 3	records a dit	records a dah
BE	BEacon mode	starts the beacon going	Exits the menu
BA	Beacon Alternate mode	selects alternate beacon sends of mem 1 and mem 2	selects send of mem 1 only (default)
ST	SideTone on/off	turns off the sidetone	turns the sidetone on (default)

O? - Record Memory 3:

The memory is recorded by sending normally. Note that the keyer output is off during the recording and that the lower command sidetone is used. When complete, PAR the mem switch. The routine will be exited automatically after the 40th character is sent. The memory is saved in flash memory which means that it will still be there even if power is removed. If this menu item is entered by mistake, PAR the mem switch to exit without changing the memory.

Playing Memory 3:

Play memory 3 with a PAR of the memory switch. - the memory starts to play after the mem switch is released. A tap of either the dit or dah switch will stop the message play.

BE - Beacon Mode:

Beacon mode will send the contents of mem 1 continuously. Start the beacon by pressing the dit switch - the beacon starts to play. Exit beacon mode by tapping the dit or dah switch.

BA - Beacon Alternate between mem 1 and mem 2 mode:

This routine selects/deselects alternating the beacon play between memory 1 and memory 2.

ST - SideTone on/off:

Since most rigs have a built-in sidetone, it is handy to be able to silence the NorCal Keyer sidetone, especially when the tone is injected into the rig audio. Note that the sidetone will still be engaged during any menu or recording entry even if it has been turned off.

Mem + both menu (PAR mem to exit)

	Menu item	pressing a dit:	pressing a dah:
T?	Record memory 1	records a dit	records a dah

T? - Record Memory 1:

Enter record mode for memory 1 with a PAH of the mem switch and both paddle switches for 2 seconds. Hold the mem switch down, then squeeze both paddle switches 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?**. Memory 1 can now be recorded. Start sending your message. when complete, press the mem key. The memory is 40 characters long - recording will terminate automatically after the 40th character. If this menu item is entered accidentally, just PAR the mem switch to exit without recording.

Playing Memory 1:

First, hold the mem switch down, next, squeeze both paddle switches (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.

Notes:

To perform a full keyer reset (parameters to their default values, memories untouched):

- 1) remove power to the keyer
- 2) press and hold the mem switch
- 3) powerup the keyer keeping the switch depressed until the FB is sent.

One unique feature of the NorCal Keyer is 5 ditdah tune mode. If both paddles are held for at least 5 ditdahs and then released, the keyer will enter tune mode (key down, sidetone on). To exit, tap either the dit or dah. Thanks to Lew Paceley, N5ZE, for inventing this mode.

The NorCal Keyer sidetone is “floated” between characters to minimize “thump” when the sidetone is injected into the rig audio chain. If the NorCal Keyer is used in a standalone fashion with a piezo sounder on the sidetone, the builder should make sure that a high-resistance DC path exists from the sidetone output pin to ground. This will prevent the NorCal Keyer from using excessive battery current while not in use. To an extent this should also be heeded with a rig installation of the NorCal Keyer - a voltage divider type of output will allow a DC path to ground.

Chuck Olson, WB9KZY

NorCal Keyer Parts List

C1 = .01uF Blue mono cap marked 103

C2 = .01uF Blue mono cap marked 103

C3 = .01uF Blue mono cap marked 103

C4 = .01uF Brown poly cap marked 103

C5 = .01uF Blue mono cap marked 103

C6 = 10uF Blue, yellow or brown Tantalum cap marked 10 With a + sign on the positive lead

C7 = .1uF Blue mono cap marked 104

R1 = 4.7K yellow purple red 1/4W resistor

R2 = 1K Brown Black Red 1/4W resistor

R3 = 10K Brown Black Orange 1/4W resistor

R4 = 100K Brown Black Yellow 1/4W resistor

Q1 = General purpose NPN may be PN2222A , 2N2222, 2N3904, etc.

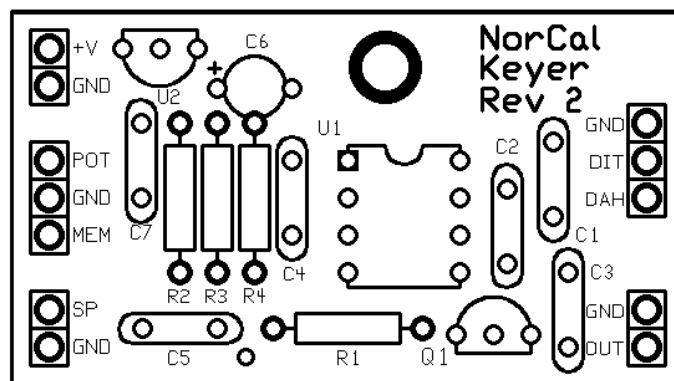
U1 = 12F629 Pic chip (8 pin DIP)

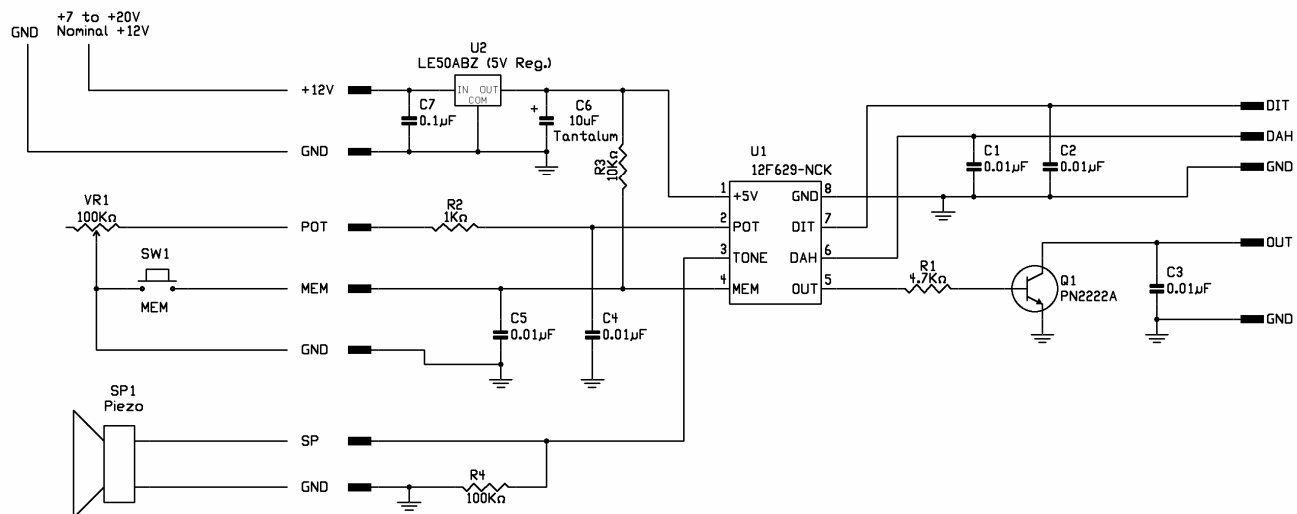
U2 = 78L05 voltage regulator may be marked LE50

Off board parts = SP1 Small piezo speaker,

Switch, PB (N.O.)

Parts not included but needed: 100K Linear Pot for speed control, Stereo jack for paddles, Mono jack for output, 9V Battery if desired





NorCal Keyer Schematic